00088490

BOMBAY BRANCH
OF THE
ROYAL ASIATIC SOCIETY
TOWN HALL, BOMBAY.

Digitized with financial assistance from the
Government of Maharashtra
on 23 January, 2019

THE

BOOK OF THE FARM,

DETAILING THE LABOURS OF THE

FARMER, FARM-STEWARD, PLOUGHMAN, SHEPHERD, HEDGER, CATTLE-MAN, FIELD-WORKER, AND DAIRY-MAID.

BY

HENRY STEPHENS, F.R.S.E.

IN THREE VOLUMES.

WITH NUMEROUS ILLUSTRATIONS.

1358

88490

VOL. II.

"Wherefore, come on, O young husbandman!
Learn the culture proper to each kind."

VIRGIL.

WILLIAM BLACKWOOD AND SONS,
EDINBURGH AND LONDON.
MDCCCXLIV.

631
Ste/Boo
88490

Ref 630.1

Ref 301.35

00088490

PRINTED BY NEILL AND COMPANY, EDINBURGH.

CONTENTS OF VOLUME II.

31. Drawing and stowing turnips, mangel-würzel, cabbage, carrots, and parsnips, ... Page 1
32. The feeding of sheep on turnips in winter, . . . 31
33. Driving and slaughtering sheep, ... 86
34. Rearing and feeding cattle on turnips in winter, . . 109
35. Driving and slaughtering cattle, ... 157
36. The treatment of farm-horses in winter, . . . 176
37. Fattening, driving, and slaughtering swine, . . . 230
38. The treatment of fowls in winter, ... 246
39. Thrashing and winnowing grain, and of the thrashing-machine, 262
40. The wages of farm-servants, ... 380
41. Corn markets, ... 389
42. The farm smith, joiner, and saddler, ... 396
43. The forming of dunghills, and of liquid manure tanks, . . 401
45. Winter irrigation, ... 422

SPRING, ... 428
46. Cows calving, and of calves, ... 437
47. The advantages of having field-work in a forward state, . 479
48. Cross-ploughing, drilling, and ribbing land, . . . 483
49. Sowing spring wheat and grass seeds, ... 502
50. Sowing beans, pease, tares, lucern, saintfoin, flax, and hemp, . 542
51. Switching, pruning, and water-tabling thorn-hedges, . . 562
52. Hiring farm-servants, ... 582
53. Sowing oat seed, ... 586
54. The lambing of ewes, ... 599
55. The training and working the shepherd's dog, . . . 625
56. Sowing barley seed, ... 628
56. Turning dunghills and composts, ... 636
57. Planting potatoes, ... 654
58. Breaking in young draught horses, ... 691
59. Sows farrowing or littering, ... 698
60. The hatching of fowls, ... 706

THE

BOOK OF THE FARM.

31. OF DRAWING AND STORING TURNIPS, MANGEL-WÜRZEL, CABBAGE, CARROTS, AND PARSNIPS.

"Beneath dread Winter's level sheets of snow
The sweet nutritious *Turnip* deigns to grow."
BLOOMFIELD.

(1219.) The *treatment of live stock* receives early attention amongst the farm operations of winter; and whether they or land get the precedence depends entirely on the circumstance of the harvest having been completed late or early. If the harvest have been got through early, there is ample time to plough a large portion of stubble-land, in preparation of green crops in spring, before winter quarters are required to be provided for stock; but should it occupy all hands until a late period,—that is, until the pastures have failed to supply stock with the requisite quantity of food,—provision for their support should be made in the steading, in preference to ploughing land. The usual occurrence is, that the harvest is entirely completed before the failure of the pasture; and, accordingly, I have described the methods of ploughing the land before taking up the subject of winter treatment of live stock; and in doing so, have included the ploughing of *lea* after that of stubble-ground, in order to keep all the particulars of winter ploughing together, although the usual occurrence is, that the live stock are snugly housed in the steading, and the stubble nearly all turned over, before the ploughing of lea is commenced, unless there happen to be an old piece of lea to plough on strong land, in which case it should be turned over before the setting in of the winter's frost.

(1220.) Sheep always occupying the fields, according to the practice of this country, the only varieties of stock requiring accommodation

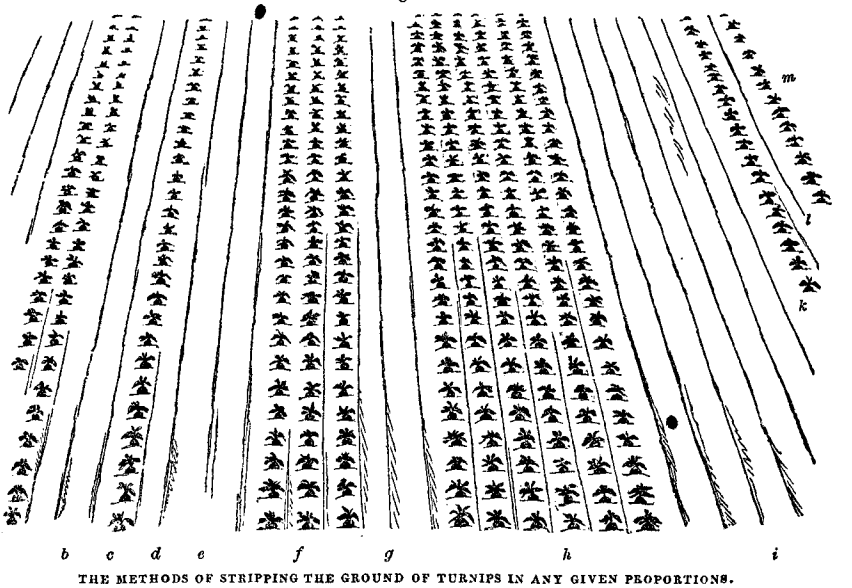
in the steading in winter are cattle and horses. The horses consist chiefly of those employed in draught, which have their stable always at command, and any young horses besides that are reared on the farm. Of the cattle, the cows are housed in the byre at night for some time before the rest of the cattle are brought into the steading, in case the coldness of the autumnal dews and frosts should injure their milking properties; so that it is only the younger and feeding cattle that have to be accommodated, and of these the feeding are generally housed before the younger stock, which usually get leave to wander about the fields as long as they can pick up any food. I am only here describing what is the common practice, without remarking whether it is a good or bad one, as the whole subject of the treatment of cattle will very soon engage our attention.

(1221.) By the time the cattle are ready to occupy the steading, *turnips* should be provided for them as their ordinary food, and the supply at all times sufficient; and it should be provided in this way. The lambs of last spring, and the ewes which have been drafted from the flock, as being too old or otherwise unfit to breed from any longer, are fed on turnips on the ground in winter, to be sold off fat in spring. The portion of the turnip-ground allotted sheep is prepared for their reception in a peculiar manner, by being *drawn or stript*, that is, a certain proportion of the turnips is left on the ground, for the use of the sheep, and the other is carried away to the steading to be consumed by the cattle. The reason for stripping turnips is to supply food to the sheep in the most convenient form, and, at the same time, enrich the ground for the succeeding crops by their dung, which is applied in such quantity as to prevent the ground being manured beyond what would be proper for the perfect development of the future crops; for it has been found, that, were an entire good crop of turnips consumed on the ground, the yield of *corn* would be scanty and ill-filled. The usual proportion drawn, if a good crop, is $\frac{1}{2}$, but should the soil be in low condition, $\frac{1}{3}$ only is taken away, and should it be in fine condition, $\frac{2}{3}$ or even $\frac{3}{4}$ may be drawn; but, on the other hand, the quantity drawn is dependent upon the bulk of the crop. If the crop is very large, and the ground in very fine condition, $\frac{2}{3}$ may be drawn, but it is rarely the case that the soil is so rich and the crop so large as to make $\frac{1}{2}$ too great a proportion to be left to be consumed. If the crop is poor, $\frac{1}{3}$ only should be drawn, and a very poor crop should be wholly eaten on, whatever condition the soil may be in. There is another consideration which materially affects the quantity to be left on the ground, which is the occurrence of a poor crop of turnips over the whole farm. Hitherto I

have only been speaking of that part of the crop of turnips which is to be appropriated to the use of the sheep, but when the entire crop is bad, that is, insufficient to maintain all the stock fully, then the proportion to be consumed by the sheep and cattle respectively, should be determined at the commencement, and maintained throughout the season, that neither class of stock may receive undue advantage. In such a case, it is evident that neither the sheep nor cattle can be fattened on turnips; and other expedients must be resorted to to fatten them, such as, either the sheep or cattle should get as many turnips as will feed them, and the other be fed on extraneous matter, or both classes of stock be left in lean condition. When foreign matters for feeding—such as oil-cake—can be procured, the cattle should get the largest quantity of them, and the sheep the largest portion of the turnips; because oil-cake can be more easily administered at the steading than turnips, and sheep, saving the trouble of manuring the ground afterwards, can more easily be supplied with turnips. Thus, then, considerations of the state of soil and crop are required to determine the proportion of the turnip crop that should be drawn; but the standard proportion is $\frac{1}{3}$, and when that is deviated from, it should only be from very urgent circumstances, such as those alluded to above.

(1222.) Fig. 208 shews how turnips are stripped in the various pro-

Fig. 208.



THE METHODS OF STRIPPING THE GROUND OF TURNIPS IN ANY GIVEN PROPORTIONS.

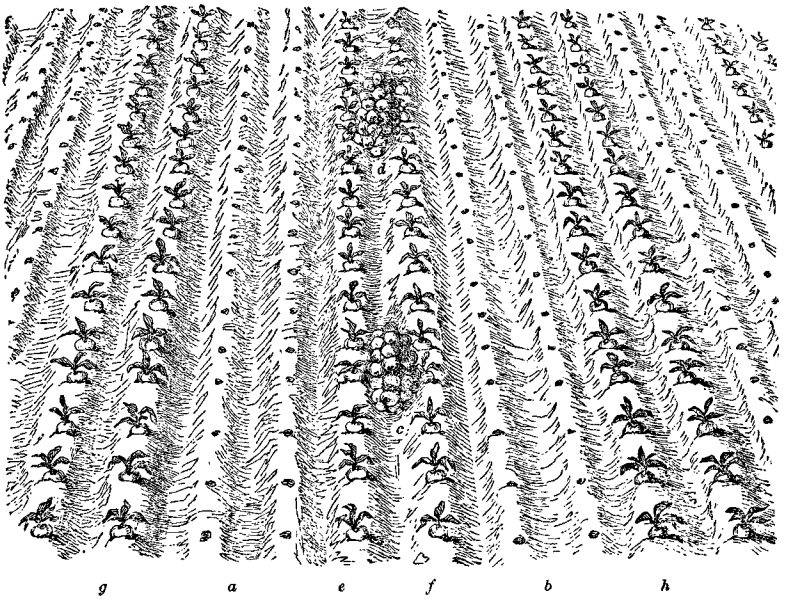
portions noticed above. When $\frac{1}{2}$ is drawn, it can be done in various

ways, but each not alike beneficial to the land; for example, it can be done by leaving 2 drills *a* and taking away 2 drills *b*; or by taking away 3 drills *e* and leaving 3 drills *f*; or by taking away 6 drills *i* and leaving 6 drills *h*; or by taking away 1 drill *l* and leaving 1 drill *k*; and so on in every other proportion. Though the same result is attained in all these different ways, in so far as the turnips are concerned, there are cogent reasons against them all except the one which leaves 2 drills *a* and takes away 2 drills *b*; because, when 1 drill only is left, as at *l*, the sheep have not room to stand and lie down with ease between *k* and *m*, without interfering with the turnips, and, besides, sufficient room is not left for horses and cart to pass along *l*, without injuring the turnips on either side with the horses' feet or the cart wheels; whereas, when 2 or more drills are pulled, as at *b*, and only 2 left, as at *a*, the sheep have room to stand and eat on either side of the turnips, and the cart can pass easily along *b* without injuring the turnips, that is, the horse walks up the centre hollow of the drills, and a wheel occupies a hollow on each side. Again, when 3 drills are left, as at *f*, and 3 taken away, as at *e*, the sheep injure the turnips of the two outside rows to reach the middle one at *f*; and much more will they injure those at *h*, when 6 drills are left; and there is, besides, this serious objection to this latter mode, that when practised on light soils, it is observed that the succeeding grain crop is never so good on the ground that has been cleared as where the turnips are left. When other proportions are determined on, $\frac{1}{3}$ may be easily left, by pulling 2 drills, as at *b*, and leaving 1, as at *c*; or $\frac{1}{4}$ may be left, by pulling 3 drills, as at *e*, and leaving 1, as at *c*; or $\frac{3}{5}$ may be left, by pulling 2 as at *g*, and leaving 3, as at *f*. There are thus various ways in which the same and different proportions of turnips may be pulled and left on the ground; but in whatever proportion they may be taken, the rule of leaving 2 empty drills for the horses and carts to pass along without injury to the turnips, should never be violated.

(1223.) But the convenience and propriety of the plan of leaving 2 and taking 2 drills, when the $\frac{1}{2}$ of the crop is to be eaten on, will be best appreciated in witnessing the mode of doing it, as shewn in fig. 209, where the drills are represented on a larger scale than in the preceding figure. One field-worker, being a woman, clears the 2 drills at *a*, and another simultaneously the other 2 at *b*; and in clearing these 4 drills, the turnips are thrown into heaps at regular distances, as at *c* and *d*, amongst the standing turnips of the 2 drills *e* and *f*, to the right of one woman, and to the left of the other; and thus every alternate 2 drills left unpulled become the receptacle of the turnips pulled by every 2 women. The cart then passes along *a* or *b*, without touching the turnips

either in *e* or *g* on the one hand, or in *f* and *h* on the other, and it clears away the heaps in the line of *c d*. In the cut the turnips are repre-

Fig. 209.



THE METHOD OF PULLING TURNIPS IN PREPARATION FOR STORING.

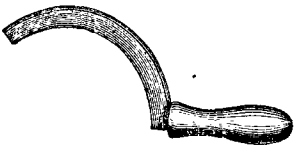
sented thinner on the ground than they usually are, but the size of the bulb in proportion to the width of the drills is preserved both in the drills and in the heaps. The seats of the pulled turnips are shewn upon the bared drills.

(1224.) The usual state in which turnips are thus placed in these temporary heaps, *c* and *d*, is with their tops on, but the tails are generally taken away. The most cleanly state, however, for the turnips themselves, and the most nutritious for cattle, is to deprive them of both *tops* and *tails*. Many, and indeed I may say most, farmers are impressed with the idea, that tops of turnips make good feeding at the beginning of the season, and especially for young beasts. The notion is quite a mistaken one, in regard to the feeding qualities of tops at any season, for there is really no *such* property in them. No doubt at that season they contain a large quantity of watery juice, which makes cattle devour them with avidity on coming into the steading off bare pasture, and they will even be eaten off before the turnips themselves are touched, when both are presented together; but observation and experience confirm me in the opinion that the time bestowed by cattle in consuming

turnip-tops is worse than so much valuable time thrown away; inasmuch as, in their cleanest state, tops are apt to produce a looseness in the bowels, arising partly, perhaps, from the sudden change of food from grass to such a succulent vegetable; and the complaint is much aggravated by the dirty, wetted, or frosty state in which they are usually given to beasts. This looseness never fails to bring down the condition of cattle so much that a considerable part of the winter passes away before they entirely recover from the shock which their system has thus received. Like my neighbours, I was impressed with the economic idea of using turnip-tops,—and I believe it is solely as regards economy, rather than a conviction of their utility, that prompts farmers to continue their use,—but their weakening effects upon cattle, especially young ones, caused me to desist from their use; and fortunate was the resolution, for ever after their abandonment my cattle throve better, and the tops, after all, were not thrown away, as they served to assist the manuring of the field on which they had grown. I have no hesitation, therefore, in recommending you to deprive the turnips of both tops and tails before carrying them to the steading for the use of cattle. Sheep are not so easily injured by them as cattle, on account, perhaps, of their costive habit; and perhaps in spring, when turnips are naturally less juicy, tops might be of service to them as a gentle aperient, but then, when they might be most useful, they are the most scanty and fibrous.

(1225.) The tops and tails of turnips are easily removed by means of a very simple instrument. Figs. 210 and 211 represent these instruments, fig. 210 being formed from a portion of an old scythe reaping-hook, with a piece of the point broken off. This is a light instrument, and answers the purpose pretty well; but fig. 211 is still better. It is made of the point of a worn patent scythe, the very point being broken off, and the iron back to which the blade is rivetted is driven into a helve, provided with a ferule around the end next the blade. This is rather heavier than the other instrument, and on that account removes the top more easily.

Fig. 210.



INSTRUMENT FOR TOPPING AND TAILING TURNIPS, MADE OF PART OF AN OLD SCYTHE REAPING-HOOK.

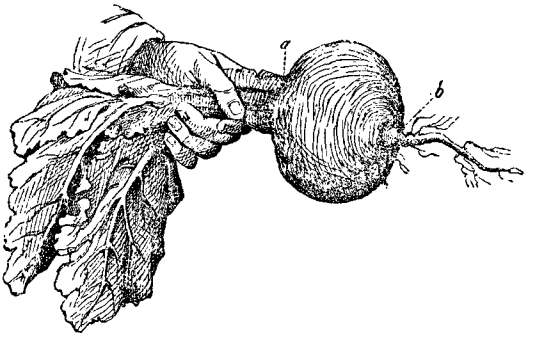
Fig. 211.

ANOTHER INSTRUMENT FOR THE SAME PURPOSE, MADE OF A PIECE OF OLD PATENT SCYTHE.

(1226.) The mode of using these instruments in the removal of the tops and tails of turnips is this. The field-worker moves along between the two drills of turnips which are to be drawn, as from *a*,

fig. 209, and pulling a turnip with the left hand by the top from either drill, holds the bulb in a horizontal position, as represented in fig. 212,

Fig. 212.



MODE OF TOPPING AND TAILING TURNIPS.

over and between the drills *e* and *f*, fig. 209, and with the hook or knife described above (1225.), first takes off the root at *b* with a small stroke, and then cuts off the top at *a*, between the turnip and the hand, with a sharper one, on which the turnip falls down into the heap *c* or *d*, whichever is forming at the time. Thus, pulling one or two turnips from one drill, and then as many from the other, the two drills are cleared to the extent desired. Another field-worker acts as a companion to this one, by going up *b*, pulling the turnips from the drills on either side of her, and dropping them, topped and tailed, into the same heaps as her companion. The tops are scattered over the cleared ground. A left and a right-handed field-worker get on best together at this work.

(1227.) Due care is requisite, on removing the tops and tails, that none of the bulb be cut by the instrument, as the juice of the turnip will exude through the incision. Of course, when turnips are to be consumed immediately, this precaution is less necessary; but the habit of slicing off a part, or hacking the skin of the bulb, indicates carelessness, and should be avoided at all times.

(1228.) When $\frac{2}{3}$ of the turnips are drawn and $\frac{1}{3}$ left, the field-worker goes up at *b*, fig. 208, and, pulling the 2 drills there, drops the prepared turnips between *c* and *d*, beyond the drill *c* that is left. When $\frac{3}{4}$ are pulled, as at *e*, and $\frac{1}{4}$ left on the ground, as at *c*, the turnips may still be dropped in the same place between *c* and *d*, the field-worker pulling all the 3 drills herself, and the horse walking along from *e* when taking them away. When 3 drills are pulled, as at *e*, and 3 left, as at *f*, which is not so good a plan of leaving the $\frac{1}{4}$ as the 2 and 2 I have

described before (1222.), the same field-worker pulls all the 3 drills, and drops the turnips along the outside row next herself of those that are left. When $\frac{3}{5}$ are left, as at *f*, and $\frac{2}{5}$ pulled, as at *g*, the field-worker goes up, pulling the 2 drills there, and dropping the turnips between the two rows next her of *f*. When 6 drills are pulled, as at *i*, which is not a good plan for leaving the $\frac{1}{2}$, 3 women work abreast, each pulling 2 drills, and all three drop the turnips into the same heap, before the woman in the middle. This plan has the sole advantage of collecting a large quantity of turnips in one place, and causing little carting upon the land. When the field is intended to be entirely cleared of turnips, the clearance is begun at the side nearest the gate, and carried regularly on from top to bottom of the field, the nearest part of the crop being taken when the weather is least favourable, and the farthest when most so.

(1229.) These last remarks remind me of mentioning, that when a field is begun to be stripped for sheep, that part should be chosen which will afford them shelter whenever the weather proves inauspicious. A plantation, a good hedge, a bank sloping to the south, or one in the direction opposite to that from which winds most prevail in the locality, or any marked inequality in the form of the ground, will afford shelter to sheep in case of necessity. On the sheep clearing this part first, it will always be ready for a place of refuge should it be required for protection against a storm. The utility of such shelter you shall be made acquainted with very soon.

(1230.) On removing prepared turnips from the land, the carts should be filled by the field-workers, as many being employed as to keep the carts a-going, that is, to have one filled by the time another approaches the place of work in the field. If there are more field-workers than will be required to do this, the remainder should be employed in topping and tailing. The topped and tailed turnips should be thrown into the carts by the hand, and not pricked by means of forks or graips; the cart should be placed alongside the drill near two or more heaps; and the carter should manage the horses and assist in the filling, until the turnips rise so high in the cart as to require from him a little adjustment in heaping, to prevent their falling off in the journey.

(1231.) As it is scarcely probable that your field-workers will be so numerous as to top and tail and assist in filling at the same time, so as to keep even 2 carts at work, it will be necessary for them to begin the pulling so much sooner, whether one yoking, or a whole day, or two days, but so much sooner, according to the bulk of the crop, as to keep the carts agoing when they begin to drive away the turnips; for it at

all times implies bad management to let horses wait longer in the field than the time occupied in filling the cart. And yet how common an occurrence it is to see horses waiting until the turnips are pulled and tailed and thrown into the cart by perhaps only 2 women, the carter building them up not as fast as he can get them, but as slow as he can induce the women to give them! The driving away should not commence at all until there is sufficient quantity of turnips prepared to employ at least two carts one yoking; and, on the other hand, care should be taken not to allow more turnips than will employ that number of carts for that time to lie upon the ground before being carried away, in case frost or rain should prevent the carts entering the field as long as to endanger the quality of the turnip.

(1232.) Dry weather should be chosen for the pulling of turnips, not only for the sake of cleanliness to the turnips themselves, but for the sake of the land, which should be cut up and poached by cart-wheels and horses' feet as little as possible; because when land is much cut up in carrying away turnips, sheep have a very uncomfortable lair, the ruts forming ready receptacles for water, and are not soon emptied. No doubt thorough draining assists to make land proof against such a condition; but let the land be ever so well drained, its nature cannot thereby be entirely changed—clay will always have a tendency to retain water on its surface, and soil every thing that touches it, when wetted by recent rains; and deep loam and black mould will still be penetrated by horses' hoofs, and rise in large masses, with wheels, immediately after rain. No turnips should therefore be led off fields consisting of these sorts of soils, however well drained, immediately after or during severe rain; nor should they be pulled at all, until the ground has again become consolidated.

(1233.) In commencing the pulling of turnips, one of the fields intended to support sheep should first be taken, in order to prepare space for them; and this is done whilst all the stock are engaged on pasture, which should not be bared too much, in case the sheep that are to be fed off on turnips fall off in condition upon it.

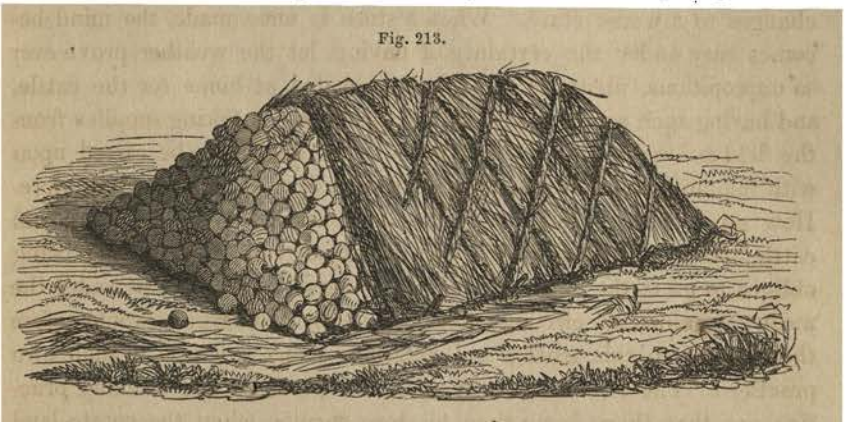
(1234.) Should the weather prove unfavourable at the beginning of the season,—that is, too wet or too frosty,—there should no more turnips be pulled and carried than will suffice for the daily consumption of the cattle in the steading; but whenever the ground is dry and firm and the air fresh, no opportunity should be neglected, except from other more important operations—such as the wheat-seed—of storing as large a quantity as the time will permit, to be used when the weather proves interruptive to field operations. This is a very important matter, and,

as I conceive, much neglected by most farmers, who too frequently place their cattle from hand to mouth for food. A very common practice is to employ one or two carts an afternoon's yoking, to bring in as many turnips as will serve the cattle for two or three days at most, and these are brought in with the tops on, after much time has been spent in the field in waiting for the pulling and tailing of the turnips. This slovenly mode of providing provender for cattle should be abandoned. It should be considered a work of the first importance in winter to provide cattle with turnips in the very best condition, independent of the vicissitudes of the weather; and this can only be done by storing a considerable quantity of them in good weather, to be used when the weather changes to a worse state. When a store is once made, the mind becomes easy under the certainty of having, let the weather prove ever so unpropitious, plenty of good food provided at home for the cattle, and having such a provision does not prevent you taking supplies from the field as long as the weather permits the ground to be carted upon with impunity, to be immediately consumed, or to augment the store. How much better for all parties—for yourself, for men, horses, and cattle,—to be always provided with plenty of turnips, instead of being obliged to go to the field for every day's supply, and perhaps under the most uncomfortable circumstances! I believe few farmers would refuse their assent to this truth; and yet, how many violate it in their own practice! The excuses usually made for pursuing the ordinary practice are, that there is no time to store turnips when the potato-land should be ploughed up and sown with wheat; that the beasts are yet doing well enough upon the pasture; and that it is a pity to pull the turnips while they continue to grow. It is proper to bestow all the time required to plough and sow the potato-land; and, after a late harvest, these may have to be done after the pasture has failed; but such an occurrence as the last being the exception to the usual condition of the crops and seasons, ought not to be adduced as an excuse applicable at all times; and as to the other excuses, founded upon the growing state of the turnips and the rough state of the pastures, they are of no force when adduced in compensation for the risk of loss likely to be incurred by a low condition in the stock. Rather than incur such a risk, give up the rough pasture to the sheep, or delay the working and sowing of the potato-land, or sacrifice a portion of the weight of a small part of the turnip crop by pulling it before reaching entire maturity. As for sheep, they are never at a loss for food, being constantly surrounded with turnips, as long as the ground is bare.

(1235.) The *storing* of turnips is very well done in this way. Let a

piece of lea ground, convenient of access to carts, be chosen near the steading for the site of the store, and, if that be in an adjoining field, on a 15-feet ridge, so much the better, provided the ridge runs N. and S. Fig. 213 represents the form of the turnip-store. The cart with the topped and tailed turnips is backed to the spot of the ridge chosen to begin the store, and there emptied of its contents. The ridge being 15 feet wide, the store should not exceed 10 feet wide at the bottom, to allow a space of at least 2½ feet on each side towards the open furrow of the ridge, for the fall and conveyance of water. The turnips may be piled up to the height of 4 feet; but will not easily lie to 5 feet on that width of base. In this way, the store may be formed of any length; but

Fig. 213.



THE TRIANGULAR TURNIP-STORE.

it is more desirable to make two or three stores on adjoining ridges, than a very long one on the same ridge, as its farthest end may be too far removed for using a wheel-barrow to remove the stored turnips. Assorted straw, that is, drawn out lengthwise, is put from 4 to 6 inches thick, above the turnips for thatch, and kept down by means of straw-ropes, arranged lozenge-shaped, and fastened to pegs driven in a slanting direction in the ground, along the base of the straw, as may be distinctly seen in the figure. Or a spading of earth, taken out of the furrow, may be placed upon the ends of the ropes, to keep them down. The straw is not intended to keep out either rain or air,—for both are requisite to preserve the turnips fresh,—but to protect them from frost, which causes rottenness, and from drought, which shrivels turnips. To avoid frost, the end, and not the side, of the store should be presented to the north, from whence frost may be expected to come. If the ground chosen is so flat, and the open furrows are so nearly on a level with the ridges, as that a dash of rain would overflow the bottom of the store,

a furrow-slice should, in that case, be taken out of the open furrows of the ridges with the plough, or a gaw cut made with the spade, and the earth used to keep down the ropes.

(1236.) When the turnips are to be used from the store, the straw on the south end is removed, as seen in fig. 213, and a cart, or the cattleman's capacious light wheel-barrow, backed to it; and, after the requisite quantity for the day has been taken out, it should be replaced over the mouth of the store.

(1237.) Some people evince a desire to place the turnip-store in the stackyard, on account, perhaps, of the straw; but there is not likely to be sufficient room, especially at the beginning of winter, for the turning of carts in an ordinary-sized stackyard. I have seen turnips stored up between two stacks, in the early part of the season, but only as a temporary expedient, when there was a scarcity of straw.

(1238.) This is not the only form of store that will preserve turnips fresh and good for a considerable time. I have seen turnips heaped about 3 feet in height, quite flat on the top, and covered with loose straw, keep very well. Other plans have been devised and tried, such as to pull them from the field in which they have grown, and set them upright with their tops on in another field, in a furrow made with the plough, and then cover the bulbs with the next furrow-slice; and another plan is to pull the turnips as in the former case, and carry them to a bare or lea field, and set them upright beside one another, as close as they can stand, with their tops and roots on. No doubt, both these latter plans will keep turnips fresh enough, and an area of 1 acre will, by these methods, contain the growth of 4 or 5 acres of the field in which they had grown; but turnips are certainly not so secure from frost in those positions as in a store; and after the trouble of lifting and carrying them has been incurred, it would be as easy to take them to a proper store at once, where they would be near at hand, and save the farther trouble of bringing them again from the second field. And even if they were so set in a field adjoining the steading, they would occupy a much larger space than any store. Objectionable as these plans are compared to triangular or flat-topped stores, they are better than storing turnips in houses, where they never fail to sprout on the top and become rotten at the bottom of the bin. Piling them against a high wall, and thatching them like a to-fall, preserves them very little better than in an outhouse. Stored in close houses, turnips never fail to rot at the bottom of the heap; and the heat engendered thereby not only endangers the rest of the heap, but superinduces on its surface a premature vegetation, very exhausting to the substance of the bulbs. Turnips put into pits dug in

the ground, and covered with earth, have failed to be preserved. A plan has been recommended to drive stakes 2½ feet high into the ground, and wattle them together with brushwood, making an enclosure of 3 sides, in the interior of which the turnips are packed, and piled up to a point, and thatched, like the store in fig. 213; and the turnips are represented as keeping fresh in such a structure until June; and one advantage attending this plan is said to be, that "where room is rather limited in the rick-yard, one pile of this description will contain 3 times as much as one of those placed on the ground of a triangular shape; and the saving of thatch is also considerable."* But, as it appears to me, the providing of stakes and the trouble of wattling around an enclosure will far more than counterbalance any advantage of space or saving of straw for thatch, compared with the mode I have described in fig. 213; and besides all these inconveniences attending the plan, there is no necessity whatever for having a turnip-store in a rick-yard.

(1239.) With regard to *storing mangel-würzel*, this plan seems unexceptionable. "It should be stored early in November. The best and cheapest mode is to build it up against some high wall, contiguous to your beasts' sheds, not more than 7 or 8 feet deep, carried up square to a certain height, and then tapering in a roof to the top of the wall; protect the sides with thatched hurdles, leaving an interval between the roots and the hurdles, which fill up with dry stubble (straw); cover the roof with about 1 foot of the same, and then thatch it, so as to conduct all moisture well over the hurdles placed as a protection to the sides. In pulling the plants, care should be taken that as little injury be inflicted upon them as possible. Cleansing with a knife should on no account be permitted, and it is safer to leave some of the leaf on, than, by cutting it too close to impair the crown of the root. The drier the season is for storing the better; although I have never found the roots decayed in the heap by the earth, which, in wet weather, has been brought from the field adhering to them."† *Carrots* may be stored exactly in the same manner, and so may *parsnips*. *Cabbages* are stored by being shoughed into the soil, or hung up by the stems, with the heads downwards, in a shed. As cabbages are very exhausting to the soil, the plants should be pulled up by the roots when they are gathered, and the stems not merely cut over with a hook or knife, because they will sprout again.

(1240.) All these modes of storing turnips apply to all the varieties of the root usually cultivated, and which are much more numerous than

* Journal of the Royal Agricultural Society of England, vol. ii., p. 228.

† Ibid. vol. ii. p. 300.

necessary. Mr Lawson enumerates and describes no fewer than 46 varieties cultivated in the field; namely, 11 of Swedes, 17 of yellow, and 18 of white,* the colour names being derived as much from the colour of the flesh as that of the skin. One kind from each of these classes seems almost requisite to be cultivated on every farm, although the yellow is omitted in some districts, and the Swedes in others. Where Swedes are omitted, they have never been cultivated, and where the yellow is the favourite, the Swedes are unknown; for where they are known, their culture is never relinquished, and their extension is treading hard upon the yellow, and even curtailing the boundary of the white. The white varieties come earliest into use, and will always be esteemed on account of their rapid growth and early maturity, though unable to withstand the severest effects of frost. It is they which first support both cattle and sheep, being ready for use as soon as the pasture fails; and in storing them, only such a quantity should be prepared as will last to the end of the year. The yellows then follow, and last for about 2 months, that is, to the end of February or thereabouts; and the same rule of storing a quantity for a specified time is followed in regard to them as with the whites. Then the Swedes finish the course, and should last until the grass is able to support the cattle, that is, to the end of May or beginning of June, to which time they will continue fresh in store, if stored in proper time and in the manner recommended above; and the *most* proper time for storing them is before any vegetation makes its appearance on them in spring, which is generally about the end of March or beginning of April.

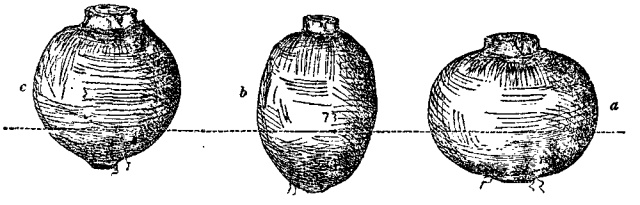
(1241.) Of all the 18 varieties of white turnips, I should say that the White Globe (*Brassica rapa, depressa, alba*, of De Candolle) *a*, fig. 214, is the best for early maturity, sweetness, juiciness, size of root, weight of crop, and elegance of form. Its form is nearly globular, as its name indicates; skin smooth, somewhat oily, fine, and perfectly white; neck of the top and tap-root small; leaves long (frequently 18 inches), upright, and luxuriant. Though the root does not feel particularly heavy in the hand, it does not emit a hollow sound when struck; its flesh is somewhat firm, fine-grained, though distinctly exhibiting fibres radiating from the centre; the juice easily exudes, and the rind is thin. Its specific gravity was determined by Dr Skene Keith at 0.840; and its nutritive properties by Sir Humphry Davy, at 42 parts in 1000; of which were, of mucilage 7, of sugar 34, and of albumen or gluten 1.† Mr Sinclair

* Lawson's Agriculturists' Manual, p. 237; and Supplement, p. 49.

† Davy's Agricultural Chemistry, p. 135, edition of 1839.

mentions this remarkable fact in regard to the white turnip, that "the quantity of nutritive matter contained in different roots of the same variety varies according to the size and texture of their substances. Thus, a root of the white-loaf turnip, measuring 7 inches in diameter, afforded only 72½ grains; while the same quantity of a root which measured only 4 inches, afforded 80 grains." So he forms this important

Fig. 214.



THE WHITE-GLOBE TURNIP. THE PURPLE TOP SWEDISH TURNIP. THE ABERDEENSHIRE YELLOW BULLOCK TURNIP.

conclusion, that "the middle-sized roots of the common turnip are therefore the most nutritious."*

(1242.) I suspect that our crops of white-globe turnip ordinarily consist of middle-sized bulbs, or they contain many blanks, as the following statement tends to shew. Taking the distance between the turnips at 9 inches—being that at which white turnips are usually thinned out—and taking the distance between the drills at 27 inches—the usual one—these distances embrace an area of 243 square inches of ground for each turnip. On each turnip occupying that area, there should be 25,813 turnips per acre imperial; and taking 30 tons per acre as a fair crop, each turnip will weigh nearly 1 lb. 1 oz.! Now, in an ordinary crop of white-globe turnips it is not beyond the truth to take them at 6 inches in diameter overhead; and having the specific gravity of white turnip as mentioned above, a 6-inch turnip should weigh 6 lb., and the crop of course be, per acre, 69 tons 2 cwt., instead of 30 tons. The inevitable conclusion is, either that blanks, to the enormous extent of being able to contain 39 tons 2 cwt. of turnips per acre, occur in the ordinary crops of white globes,—that is, the number on the acre is only 9445 turnips, instead of 25,813; or the average distance between the turnips must be 20 inches instead of 9. When actual results fall so very far short of anticipation, the important and interesting inquiry arises, Whether the great deficiency is occasioned by the death of plants

* Sinclair's Hortus Gramineus Woburnensis, p. 406–7, edition of 1824.

after the singling process has been completed? or the average size and weight of each turnip are much less than we imagine? or the distance left by the singling is greater than we desire?—or from all these causes combined? From whichever of these causes, singly or combined, the result arises, it is worthy of serious investigation by the farmer; for the bulk of the crop may really depend more on these less obvious circumstances than on the mode of culture. Let us see.

(1243.) Weights and sizes of turnips have already been ascertained with sufficient accuracy. The white globes exhibited at the Show of the Highland and Agricultural Society at Inverness in October 1839, gave a girth varying from 28½ to 34 inches, and a weight varying still more—from 8 lb. to 15½ lb. each root; so that 3 roots of the same girth of 30½ inches, varied in weight respectively 8 lb., 9¾ lb., and 14½ lb.* After the statement of these facts, our surprise at realization falling so far short of expectation may be moderated; for we see crops, of apparently the same bulk, weigh differently; and turnips growing on the same field exhibit different fattening properties; and different localities produce turnips of different bulk. Whence arise these various results? These weights are by no means the utmost to which this turnip attains, examples occurring in some seasons of weights from 18 lb. to 23 lb.;† and I have pulled one from amongst Swedes, weighing 29 lb., including the top.‡ From 30 to 40 tons per imperial acre is a good crop of this kind of turnip.

(1244.) Of the yellow turnip, Mr Lawson has described 17 varieties, of which perhaps the greatest favourite is the green-top Aberdeen Yellow Bullock (*Brassica rapa, depressa, flavescens*, of De Candolle). This is a good turnip, of the form of an oblate spheroid, as seen at *c*, fig. 214; colour of the skin below the ground, as well as of the flesh, a deep yellow orange, and that of the top bright green. The leaves are about 1 foot long, dark green, rather soft, spreading over the bulb, and collected into a small girth at the top of the turnip; the tap-root small. Its specific gravity, as determined by Dr Keith, is 0.940; and its nutritive property, according to Sinclair, is 44 in 1000 parts, of which 4¾ are of mucilage, 37¾ of sugar, and 1½ of bitter extract or saline matters. This

* Quarterly Journal of Agriculture, vol. x. p. 456.

† Lawson's Agriculturists' Manual, p. 253-4.

‡ The Norwich Mercury, of July 1841, makes mention of a turnip,—a white one, we presume,—exhibited at Fakenham market, and sent from Van Diemen's Land in strong brine, which weighed 84 lb., having a girth of 5 feet 2 inches. It is said to have weighed 92 lb. when pulled.

root feels firm and heavy in the hand, with a skin smooth and fine, flesh firm, but not so juicy, nor the rind so thin as the globe.

(1245.) Selected specimens exhibit a circumference of the larger diameter of from 27 to 30 inches, which vary in weight from 6 lb. to 8½ lb. each, but specimens may be found weighing as much as from 9 to 11 lb., and those of the same diameter sometimes shew a difference of 1 lb. in weight: yellow turnips seldom yield so heavy a crop as either the globe or Swedes, 30 tons the imperial acre being a good crop; but their power of fattening is greater than that of white turnips. In some parts of the kingdom, they are grown in preference to Swedes, especially where light soils predominate; but from my own experience in raising Swedes on the driest gravelly soil, of a superior description to the yellow, I believe that if Swedes always received the sort of culture they require, they would in every soil exceed the yellows in weight and nutrition; and a strong proof of the soundness of this opinion may be found in the rapid inroads which they have of late years made, and are making, upon the confines of the yellows.

(1246.) Of the 18 varieties of the Swedish turnip described by Mr Lawson, the Purple-Top (*Brassica campestris, napo-brassica, rutabaga,* of De Candolle,) has long obtained the preference, and certainly if weight of crop, nutritious property, and durability of texture are valuable properties in a turnip, none can exceed the Swedes. They are of an oblong form, as seen at *b*, fig. 214, having the colour under ground and of the flesh a deep yellow orange, and the upper part above the ground a dusky purple. The leaves are about 1 foot long, standing nearly upright, of a bluish green colour, and growing out of a firm conical base, which forms the neck of the bulb. The skin is somewhat rough, the rind thicker than either of the two former sorts of turnip, and the flesh firm. This turnip feels heavy and very hard in the hand. According to Dr Keith, the specific gravity of the yellow Swede is 1.035, and of the white 1.022, and Sir Humphry Davy estimates its nutritive property at 64 in 1000 parts, of which 9 are starch, 51 sugar, 2 gluten, and 2 extract. Dr Keith states that he found the Swedish turnip heaviest in April, at the shooting out of the new leaves, and that after its flower stem is fairly shot in June, the specific gravity of the root decreases to 0.94, that exactly of the yellow turnip. This fact shews the relative values of those turnips, and also of the time in spring, namely, before April, for storing the Swedes, after which they should not remain in the ground in a growing state. As Sir Humphry experimented on Swedish turnips grown in the neighbourhood of London, where they are confessedly in-

ferior to those in the northern counties, his results as to their nutritive properties may be considered below the true mark.

(1247.) Picked specimens have exhibited a girth of from 25 to 28 inches, varying in weight from 7 lb. to 9½ lb., but the weight of this, like all other turnips, is not in proportion to the bulk, as a 25-inch one gave a weight of 9½ lb., whilst one that measured 26 inches only weighed 7 lb. It is not an uncommon thing, however, to see them from 8 lb. to 10½ lb. A crop of from 16 to 20 tons may be obtained by very ordinary culture, but in the neighbourhood of large towns, such as Edinburgh, from 28 to 34 tons are obtained on the imperial acre. I have heard of 50 or 60 tons boasted of, but suspect that such weights had been calculated for the whole field from very limited and selected spots; nevertheless, a large and equal crop will sometimes be obtained, under favourable circumstances, for I remember seeing a crop of 50 acres within the policy of Wedderburn, Berwickshire, in 1815, then farmed by Mr Joseph Tod, Whitelaw, on traversing which I could not detect a single turnip of less apparent size than a man's head. The crop was in no part weighed, but it was let to be consumed by cattle and sheep, the half being eaten off by wether sheep at 6d. a-head per week, and realized L.21 per imperial acre! Taking a man's head at 7 inches in diameter, and the specific gravity of a Swedish turnip at 1.035, the weight of each turnip should have been 11½ lb., and taking 19,360 turnips per acre, at 12 inches apart, the distance at which Swedish turnips are singled, and 27 inches wide in the drill, the weight of the crop should have been 99 tons 7 cwt. Taking the calculation in another form, let us see the result of L.21 at 6d. a-head per week. That gives 32 sheep to the acre, and taking Mr Curwen's estimate of a sheep eating 24 lb. a-day, exclusive of 4 lb. a-day of waste, for 180 days, or half a-year, the weight of crop by this method should have been 61 tons 14 cwt. Statements, however, regarding the quantity of turnips eaten by sheep are various. One given by Sir John Sinclair is a consumption of 21 acres of 44 tons each, by 300 sheep in 180 days, or half a-year, which gives 38 lb. a-day for each sheep.* If we take this allowance of 38 lb., the crop mentioned above should have weighed 85 tons 1 cwt. to have paid L.21 per acre! The usual allowance is 16 young sheep to the ordinary acre of 30 tons, which is 23⅓ lb. a-day to each, and 10 old sheep, which is 37⅓ lb. to each, and both are probably near the truth; but the exact consumption of food by live-stock is a subject worthy of experimental investigation.

(1248.) The proportion of the top to the root is less in the Swedish

* Sinclair's Account of the Husbandry of Scotland, vol. ii. Appendix, p. 47.

than in other sorts of turnips, as evinced in the experiments of Mr Isaac Everett, South Creake, Norfolk, which, on a crop of Swedes grown at 18 inches, and 27 inches apart in the rows, of an average of 17 tons 9 cwt., gave 3 tons 3 cwt. of tops, on the 15th December, after which they were not worth weighing; and while mentioning this experiment, I may advert to a fact derivable from it, that tops are lighter in a crop raised on drills than one in rows on the flat surface; that is, whilst, in the above case, 28 tons 8 cwt. of topped and tailed turnips afforded only 5 tons 10 cwt. of tops from the drilled land, those from the rows on the flat surface yielded 6 tons 16 cwt. from a crop very little heavier, namely, 28 tons 16 cwt.

(1249.) The yellow turnip will continue fresh in the store until late in spring, but the Swedes have a superiority in this respect to all other turnips. The most remarkable instance I remember of Swedes keeping in the store, in a fresh state, was in Berwickshire, on the farm of Whitsome Hill, when in the possession of Mr George Brown, where a field of 25 acres of excellent Swedes was pulled, rooted, and topped, and stored in the manner already described, in fine dry weather in November. This extensive storing was undertaken to have the field sown with wheat. The store was opened in February, and the cattle partook of the turnips and continued to like them until the middle of June, when they were sold fat, the turnips being then only a little sprouted, and somewhat shrivelled, but exceedingly sweet to the taste. There is a property possessed by the Swedish turnip which stamps a great value upon it as a root for feeding stock, which is, the larger it grows the greater quantity of nutritive matter it contains. According to Sinclair, 1728 grains of large-sized Swedes contained 110 grains of nutritive matter, whereas small-sized ones only yielded 99 grains,* affording a sufficient stimulus to the farmer to raise this valuable root to the largest size attainable.

(1250.) A comparative view of the specific gravity and nutritive properties of the turnips just described may prove to you both an interesting statement and a memorandum of facts, as far as at present known.

Specific gravity of yellow Swedish turnip in December, . . .	1.035
It is heaviest in April, about the shooting of the new leaves, and in June, after the development of the flower stalk, it is . . .	0.940
Specific gravity of white ditto, ...	1.022
... ... yellow bullock, ...	0.940
... ... white globe, ...	0.840
... ... carrot, ...	0.810†

* Sinclair's Hortus Gramineus Woburnensis, p. 407.

† Keith's Agricultural Report of Aberdeenshire, p. 302.

Grains.	Mucilage, or Starch.	Saccharine matter.	Gluten.	Extract or saline matter.	Total soluble or nutritive matter.
1000 of Swedish turnip contains	9	51	2	2	64
... yellow bullock, . .	4¾	37¾	—	1½	44
... white globe, . .	7	34	1	—	42
... mangel würzel, .	13	119	4	—	136
... orange-globe, . .	25¾	106¾	1¼	less than 1	135½
... sugar-beet, . .	17¾	126¾	1¼	1	146¾
... field-cabbage, . .	41	24	8	—	73
... carrot (red), . .	3	95	—	½	98½
... carrot (white), . .	2	98	—	1	105
... kohl-rabi, . .	—	—	—	—	60
... parsnip, . . .	9	90	—	—	99*

(1251.) A summary of the foregoing results may here be given, thus:—A 7-inch diameter of white turnip affords 72½ grains, whereas a 4-inch turnip yields 80 grains of nutritive matter in the same bulk. On the contrary, a large Swedish turnip affords 110 grains, and a small one only 99 grains of nutritive matter in the same bulk. Swedish turnip is superior to cabbage in nutritive matter in the proportion of 110 to 107½; the white turnip inferior in the proportion of 80 to 107½; and carrots superior in the proportion of 187 to 107½. A good crop of Swedes weighs from 30 to 35 tons, of yellow from 30 to 32 tons, and of white globe from 30 to 40 tons the imperial acre. A bushel of turnips weighs from 3 stones to 3 stones 3 lb. of 14 lb. to the stone, that is, from 42 to 45 lb. the bushel. A young sheep eats about 18 lb., and an old one about 24 lb. of turnips every day;† or, by another authority, a young sheep eats 23 lb., and an old one 37 lb. a day. The usual allowance to an ordinary crop of turnips is 20 young Black-faced, or 16 Leicester, and 16 old Black-faced and 10 Leicester, or 1 three-year-old ox to the imperial acre; that is, a young Black-faced will consume about 126 lb., an old one 168 lb.; a young Leicester 161 lb., an old one 259 lb., and an ox about 1 ton of turnips every week. For sheep a crop of turnips of 30 tons will be required, and one of 26 tons will suffice for an ox during 180 days. In making this last estimate, the state of the crop should be taken into con-

* Journal of the Royal Agricultural Society of England, vol. ii. p. 298; Sinclair's Hortus Gramineus Woburnensis, p. 407; Davy's Agricultural Chemistry, p. 135.

† Curwen's Agricultural Hints, p. 39.

sideration, a crop of small yellow or white turnips, if regular, takes longer time to consume in proportion to the bulk than a crop of larger turnips, but a crop of large Swedish turnips, though apparently thin on the ground, takes a much longer time to be consumed than a thicker crop of small roots. There is *no certainty* in these calculations; at the same time, they are perhaps near enough the truth to enable you to lay on to turnips such a lot of sheep or cattle as will about consume a crop in a given time.

(1252.) The prices of turnips depend almost entirely on the demand of the locality. In the neighbourhood of towns they are always high priced, where an ordinary crop of white will fetch L.10, of yellow L.12, and of Swedes L.16 an imperial acre. They are chiefly purchased by milkmen, or cowfeeders as they are usually called in Scotland. In the country, about L.5, 10s. for white, and L.8 for Swedish turnip, to be carried off the land, are given; and when consumed on the ground by sheep, L.3 to L.5 an acre are considered a fair price; and when on the premises by cattle L.5 for white, and from L.5 to L.7 per acre for Swedes, with straw. A fairer plan for both the raiser and consumer of turnips is to let them by week at so much a head of stock put on to consume them. At the usual price of 3d. per head per week for young sheep, for the ordinary period of 26 weeks, makes a cost for keep of 6s. 6d. for the season; and if it take 16 sheep to consume an acre, the turnips will realize about L.5, 5s. per acre. For old sheep 6d. per head per week is given, which is just double the cost for the season of the other, namely 13s., which, for 10 sheep, will realize L.6, 10s. per acre. For cattle 5s. per head per week are given, with straw; and if an ox take 26 weeks to eat an acre, the turnips will realize L.6, 10s. Thus, an acre of turnips that will support 10 old sheep for the season is worth more than one that will support 16 young sheep; but why old sheep should cost more to keep them than young does not appear; it would be fairer for the owner of the sheep to make the rate of keep exactly proportionate between the young and old. In plentiful years 2d., and in scarce years 4d., per head are given for young sheep, and other stock in proportion.

(1253.) These three kinds of turnip seem to possess all the properties desiderated by the farmer, and more than these, in my opinion, need not be cultivated: for although, in peculiar seasons, it is possible that in a particular locality some other variety may attain greater perfection and prolificacy, yet I believe that, in the long run, these will bear comparison with any variety that has yet been introduced into cultivation, provided they are of pure kinds.

(1254.) There are one or two hybrids of turnips worth mentioning, and which are so named, although it is probable that most of the varieties of turnips in use are natural hybrids. One is called Dale's Hybrid, being a cross betwixt the green-topped Swede and the globe, but whether the white or green-topped globe I do not know. It possesses more of the properties of the yellow turnip than of either of its progenitors; and it has the advantage of arriving sooner at maturity, and may therefore be sown later than the ordinary yellow turnip. The other hybrid is called the Lawtown Hybrid, being a cross between the green-topped Swede and the green-topped globe, the result of which is a heart-shaped, white-fleshed, green-topped turnip, considerably harder than the globes with its leaves set on like those of the Swedes. The results of these two crosses are, a yellow turnip, Dale's, which arrives sooner at maturity than the older varieties, and a white globe, the Lawtown, which is more hardy than any other variety of white.

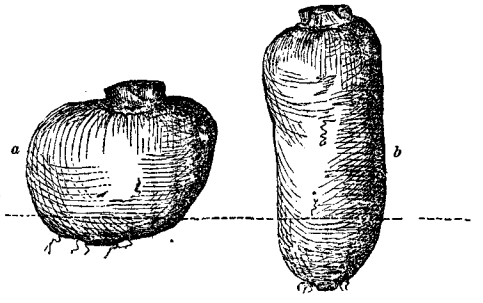
(1255.) With regard to the crop afforded by these hybrids, in an experiment made, in 1835, by Mr John Gow, Fettercairn, Kincardineshire, the Dale attained to 28 inches in girth, and yielded 23 tons, and the Lawtown to 32 inches in girth, and yielded 27 tons the imperial acre.*

(1256.) Although storing is the proper method of securing turnips for use during a storm of rain or snow, when the turnip-field should not be entered by a cart; yet it is necessary that you should be provided with expedients for obtaining food for your cattle should you be overtaken by a storm, with a scantiness of provision in hand. As both rain and snow exhibit prognostics of their approach, and should these indicate a serious fall or storm, send all the field-workers and ploughmen to the turnip-field, and pull the turnips in the form in which the land is in the course of being stripped; and, removing only the tails, throw the turnips into heaps of from 3 to 6 cart-loads each, according to the thickness of the crop, taking care to place the tops of the uppermost turnips on the heap upon the outside, in order to protect the bulbs from frost, should it come suddenly and unaccompanied with snow. To these heaps rain will do no harm, and they will serve to point out where they are, should snow cover them and the ground. As the turnips gathered in frost or snow should be immediately consumed and not stored, they may be thrown into the cart with a fork or graip, and their tops taken off at the steading, where this process can be done in the severest weather, when women could not stand out in the field to do it.

* Lawson's Agriculturist's Manual, pp. 241, 245, and 257.

(1257.) I have given fig. 215 to shew you what I conceive to be an

Fig. 215.



AN ILL-SHAPED TURNIP. THE TANKARD TURNIP.

ill-formed turnip, and also one which stands so much out of the ground as to be liable to injury from frost; where *a* is an ill-formed turnip, inasmuch as the upper part of it around the top being hollow, rain, snow, or rime may lodge there, and find their way into the heart, and corrupt it, as is actually found to take place. All white turnips, when allowed to remain on the ground after they have attained maturity, become soft and spongy, of inferior quality in the heart, and susceptible of putrefaction, which frequently overtakes them in sudden changes from frost to thaw, and reduces them into a saponaceous pulp. This fact supplies a strong reason for storing white turnips after they come to maturity, which state is indicated by the leaves losing their green colour and becoming flaccid. There are some sorts of white turnips that become spongy in the heart early in the season; and among these I would pronounce the Tankard-shaped, such as is represented by *b* in fig. 215; as are also a flat-shaped red-topped, and a small flattish white turnip, both much cultivated among small farmers, because, being small, they are supposed to require little manure to bring them to maturity, and this class of people are apt to spread manure as thin as possible upon the land, to make it go the farther. I need scarcely tell you that thrift attends the cultivation of only the best varieties of turnip. The dotted line in figs. 214 and 215 represents the surface of the ground, by which will be seen the relative depths to which these kinds of turnips descend into the soil when growing.

(1258.) I think it useful to give you a tabular view of the number of turnips there should be on an imperial acre, at given distances between the drills, and between the plants in the drills, and of the weight of the crop at specified weights of each turnip, that you may compare actual receipts with defined data, and

endeavour to ascertain whether differences in the crop in these respects arise from deficiency of weight in the turnip itself, or too much thinning out of the plants. The distance between the drills is taken at the usual width of 27 inches, the distance between the plants is what is allowed to the different sorts of turnips, and the imperial acre contains 6,272,640 square inches. On altering the width between the drills, a calculation from these data can easily be made of what ought to be the weight of crop at these given weights of turnips.

Usual distance between the drills.	Usual distances between the plants.	Area occupied by each plant.	Number of turnips there should be, per imp. acre.	Weight of each turnip.	Weight which the crop should be, per imperial acre.
Inches.	Inches.	Square inches.		lb.	Tons. Cwt.
27	9 between the plants of white turnips.	243	25,813	1	11 10
				2	23 0
				3	34 11
				4	46 0
				5	57 12
				6	69 2
				7	85 2
				8	92 0
27	10 between the plants of yellow turnips.	270	23,232	1	10 7
				2	20 14
				3	31 1
				4	41 8
				5	51 15
				6	62 2
				7	72 9
				8	82 16
27	11	297	21,120	1	9 8
				2	18 16
				3	28 5
				4	37 13
				5	47 3
				6	56 11
				7	66 0
				8	75 8
27	12 between the plants of Swedes.	324	19,360	1	8 13
				2	17 6
				3	25 19
				4	4 12
				5	43 5
				6	51 18
				7	60 11
				8	69 4

On comparing an usual crop of 20 tons of Swedes with these data, and keeping in view the distance of 12 inches aimed at between the plants, the inevitable conclusion is, that the average weight of each turnip in that crop must be less than 3 lb., or the distance between the turnips greater than 12 inches. In the one case your skill in raising a crop is almost rendered abortive, and in the other your negligence in wasting space by too much thinning out appears conspicuous. An amendment in both particulars is therefore requisite, and fortunately is attainable in both; for, as you perceive that but a slight difference in either of these particulars makes a great difference in the weight of the crop, your endeavour should be both to make the turnip heavy, and to maintain the desired distance between the plants inviolate. For example, 5 lb. turnips, at 9 inches asunder, give a crop of 57 tons 12 cwt.; whereas the same weight of turnip at 11 inches apart, gives a crop of 10 tons less. Now, how easy is it for careless people to thin out the plants to 11 instead of 9 inches, and yet, by so doing, a difference of no less than 10 tons, or 18 per cent. on a crop, is sacrificed. And again, a difference of only 1 lb. on the turnip—from 4 lb. to 5 lb.—at 9 inches asunder, makes a difference of 11 tons, or 25 per cent. per acre on the crop! So that a difference of only 1 lb. in each turnip, and 2 inches in the distance between them, makes the enormous difference of 21 tons on the whole crop! Who will say, after this, that these particulars do not require the most serious consideration in the treatment of the turnip crop?

(1259.) On comparing the amount of what the crop should be with instances given in the newspapers of what are considered great crops, it will be seen that these after all are no more than what they should be; and they are only the result of what might be expected to be attained by combined skill and care in culture. In the instances adduced in the Mark-Lane Express in 1840, crops were considered heavy which ranged from 40 to 60 tons per acre; and the Leinster Express of the same year mentions turnips having been raised on Lord Charleville's property in Ireland to a still greater amount, namely, of yellow Aberdeen 49 tons 13 cwt., of yellow Tancred 60 tons 10 cwt., of Swedish 60 tons 10 cwt., and of white Tancred 79 tons 18 cwt. Such statements prove one of two things, either that large crops of turnips are more easily raised than farmers deem practicable, or great errors have been committed in making out these results. It is quite possible for great errors to be committed in making returns from any other mode of ascertaining the amount of a crop of turnips than by topping and tailing a whole field, and weighing every cart-load separately. For example. Suppose that 1 square yard is measured in a field of turnips in this way, that is, if the distance of 1 yard is measured *from a turnip* (see fig. 208), along a drill, then the yard will embrace 5 turnips of white and 4 of Swedes; whereas, if the measurement is begun *between two turnips*, the same measure will only embrace 4 turnips of white and 3 of Swedes, making, in the former case, a difference in amount of 1 turnip out of every 5, and in the latter, 1 out of every 4; and if the weight of a statute acre has been calculated on such-like data, the crop will, in the case of the white turnips, be returned $\frac{1}{5}$, and in that of the Swedes $\frac{1}{4}$ beyond the truth. Again, if the yard is placed *across two drills*, their produce will be included within the yard, the distance between them being only 27 inches; but if the yard be placed across one drill only, then its produce alone will be included, as the yard will not reach to the drill on either side, and if the produce of the whole field is calculated on such data, the result, in the latter mode of measurement, will just give half

the amount of the other. Such ways of ascertaining the weight of a crop, when thus plainly stated, appear ridiculous enough; but it is an error which country people, who are not aware of the effects of the powers of numbers when squared, are very liable to fall into. The part of the field, too, from which the data are taken, may make a very great difference in the result over the whole; as even on true turnip-soil, how different will the size and number of turnips be on a rising knoll and a hollow! The difference is not very obvious on looking upon the tops alone, but it is made very apparent after sheep have eaten off the leaves, and just begun to break upon the bulbs. The plan, too, of filling one cart-load or so and weighing it, and filling the rest of the cart-loads to a similar extent, without weighing them, is a fallacious one, when the fact is, as shewn above, that turnips grown on the same field differ in weight, and therefore a few more or less in a small cart-load, will make a considerable difference in the amount over the whole field. I question much whether any person ever weighed every cart-load of turnips as they were brought out of a field, or ever measured many places of the same field, to ascertain the number and weight of turnips in them, and unless some plan approaching to either or both of these are adopted, the results obtained will never prove satisfactory. When the trouble of weighing every cart-load is wished to be avoided, the smallest and the largest and the middle-sized turnips should be pulled, topped, and tailed, and chosen from every part of the field where a difference of size and number are found to occur, such as in hollows, on knolls, on sloping and level ground, at the top and bottom of the field, and each turnip weighed, and the tops weighed too, separately if desired, and then the average weight of the turnip may be relied on. A convenient machine for such a purpose is one of Salter's spring steel-yards, with a basin suspended from it by chains, in which a turnip may be placed with ease and celerity. Besides doing this, the distance from centre to centre of the tops of the turnips before they are pulled should be measured, and noted down, and the average distance from turnip to turnip would then be ascertained. Having thus obtained correct data of the weight and number of turnips within the given limits of a field, the amount of the crop would then be so ascertained as to ensure confidence in the result. The average girth of the turnips could be ascertained at the same time if desired; but this is not an essential element in determining the weight of the crop.

(1260.) It may prove interesting to you to know the periods at which the various kinds of turnips in culture were introduced. According to the name given to the plant in this country, the Swedes are natives of Sweden; the Italian name *Navoni de Laponia* intimates an origin in Lapland, and the French names *Chou de Lapone, Chou de Swede*, would indicate an uncertain origin. Sir John Sinclair says, "I am informed that the Swedes were first introduced into Scotland in *anno* 1781–2, on the recommendation of Mr Knox, a native of East Lothian, who had settled at Gottenburgh, whence he sent some of the seeds to Dr Hamilton."* There is no doubt they were first introduced into Scotland from Sweden, but I believe their introduction was prior to the date mentioned. The late Mr Airth, Mains of Dunn, Forfarshire, informed me that his father was the first farmer who cultivated Swedes in Scotland, from seeds sent him by his eldest son, then settled in Gottenburgh, when my informant,

* Sinclair's Account of the Husbandry of Scotland, vol. i. p. 278, *note*.

the youngest son of a large family, was a boy of about 10 years of age. This would make the date of their introduction 1777; and this date is corroborated by the silence preserved by Mr Wight regarding the culture of such a crop by Mr Airth's father when he undertook the survey of the state of husbandry in Scotland, in 1773, at the request of the Commissioners of the Annexed Estates, and when he would not have failed to report so remarkable a circumstance as the culture of the Swede. Mr Airth sowed the first portion of seed he received in beds in the garden, and transplanted the plants in rows in the field, and thus succeeded in raising good crops for some years, before sowing the seed directly in the fields. I have not been able to trace the history of the yellow turnip; but it is probable that it originated, as is supposed by Professor Low, in a cross between a white and the Swede;* and, as its name implies, this may have been in Aberdeenshire. All the white varieties of field turnips obtained at first the name of the "Norfolk whites," from the circumstance of their having been first cultivated in that county, to any extent, by Lord Townshend, who, on coming home from being ambassador to the States-General, in 1730, paid great attention to their culture, and for which good service he obtained the appellation of "Turnip Townshend." It is rather remarkable that no turnips should have been raised in this country in the fields until the end of the 17th century, when it was lauded as a field-root as long ago as Columella, and in his time even the Gauls fed their cattle on them in winter. The Romans were so well acquainted with turnips that Pliny mentions having raised them 40 lb. weight.† Turnips were cultivated in the gardens in England in the time of Henry VIII.‡ Dale's hybrid originated in a few ounces of a hybridal seed being sent, in 1822 or 1823, by the late Mr Sherriff of Bastleridge, Berwickshire, to Mr Robert Dale, Libberton West Mains, near Edinburgh, who, by repeated selection and impregnation, brought it to what it is, a good yellow turnip, and now pretty extensively cultivated.§ The Lawtown hybrid originated about 8 or 10 years ago by Captain Wright of Lawtown, in Forfarshire, crossing the green-topped white with the green-topped Swede, to harden the white, which object proved successful, but its culture has not been pushed. By sowing the Swede beside the white Lawtown the latter has been converted into a yellow turnip, possessing the properties of the Swede; and were the cross still farther pushed, I have no doubt that a distinct variety of the Swede would be obtained. A variety of Swedes was brought into notice, about 4 or 5 years ago, by Mr Laing, Duddo, Northumberland, who found it amongst his ordinary Swedes, and observed it by its remarkably elegant form of leaf, which is much notched near the base. It is getting into use, and possesses the valuable property of resisting the effects of spring for at least a fortnight longer than the common varieties, as I had a favourable opportunity of observing in Berwickshire late in spring 1841, and on this account may be stored and kept in a fresh state to a very late period of the season.

(1261). As *cabbages* are considered good food for cows giving milk, it may be desirable to say a few words as to their use. The varieties of cabbage most suited for field culture are the Drum-head (*Brassica oleracea, capitata, depressa*), and

* Low's Elements of Practical Agriculture, p. 290.

† Dickson's Husbandry of the Ancients, vol. ii. p. 250–4.

‡ Phillips' History of Cultivated Vegetables, vol. ii. p. 365.

§ Lawson's Agriculturists' Manual, p. 241.

the great round Scotch or white Strasburgh, from which the German sour krout is chiefly made (*Brassica oleracea, capitata, spherica alba* of De Candolle). Of these two the drum-head is the most productive, and the Scotch stands the winter best. It is alleged by Sinclair that, for the purposes of the dairy, 1 acre of cabbages is worth 3 of turnips, but wherein this advantage consists is not stated, which it ought to have been, as he mentions, that the nutritive matter contained in Swedish turnips is superior to that in the cabbage in the ratio of 110 to 107½. There is no doubt, however, that the taste of milk is less tainted by cabbages than turnips, and I believe more milk may be derived from them; but there is considerable difference of opinion with respect to the effects of cabbage on butter and milk, and there is no doubt that a decayed leaf or two in a head of cabbage will impart both to butter and milk a strong disagreeable taste. " This," says Sinclair, " I have long had an opportunity of proving."* If planted in drills usually made for turnips, these two kinds of cabbage will require to be placed in good soil, 18 inches asunder at least, which will give 12,907 plants to the acre, and, at 24 inches apart, the number of plants will be 9834; and if they at all attain to the weight that cabbages sometimes do, that is from 18 lb. to 23 lb. each, the lowest number, 18, will give a crop of 78 tons; but the usual crop is from 35 to 40 tons per acre. Their uses are to feed milch cows, to fatten oxen, and sheep are very fond of them. It is questionable how far their culture should be preferred to turnips, excepting on soil too strong for turnips, as they require a fine deep strong soil and a large quantity of manure, means too valuable to be expended on cabbages, as an economical crop, in Scotland. I have no experience of the cabbage as a food for milch cows or feeding cattle, but know they are much relished by ewes at the season of lambing.

(1262.) The turnip-rooted cabbage (*Brassica campestris, napo-brassica, communis* of De Candolle) is little known in English culture, though it is cultivated in the fields in France. Its root is either white or red, and its neck and petioles greenish or purplish. It has a woody short stem, produced by the formation and decay of the leaves, and as new leaves are formed by the central bud of the stem, the lower leaves drop off, and thus the top of the bulb assumes the appearance of a stem; and Dr Neill observes it has a root under ground as sweet as a Swedish turnip. In both these respects it is very similar to our Swedish turnip, but whether it could be made to assume the form of, or has given origin to, that valuable root, I must leave to be determined by the botanical physiologist.

(1263.) The cow-cabbage or Cesarean kale (*Brassica oleracea, acephala, arborescens* of De Candolle), which created such a noise a few years ago, deserves only a passing notice. " This plant," says Don, " is almost similar in habit to the palm kale, but the stem rises to the height of from 10 to 16 feet, the leaves are not so puckered nor rolled inwards at the edges, nor do they hang down so much. The stem is naked and simple, crowned by a head of leaves like a palm-tree. Sixty plants of this variety are said to afford sufficient provender for one cow for a year, and as the side leaves are only to be used, it lasts four years without fresh planting. In La Vendee it is said to attain the height of 12 or 16 feet. In Jersey this plant is sufficiently hardy, and where it grows from 4 to 12 feet. The little farmers there feed their cows

* Sinclair's Hortus Gramineus Woburnensis, p. 407.

with the leaves, plucking them from the stem as they grow, leaving the crown at the top. The stems being strong, are also used by them for roofing small outhouses. When the gathering of the leaves are finished, at the end of the year, the terminating bud or crown is boiled, and is said to be particularly sweet. It is not sufficiently hardy to stand the climate of Britain, unless planted in a very sheltered situation."*

(1264.) There is still another variety of the cabbage tribe which deserves notice,—the turnip-stemmed cabbage or khol-rabi (*Brassica oleracea, caulo-rapa, alba* of De Candolle). The varieties of this plant are numerous, but the best suited for field-culture are the large red and green sorts. It is a native of Germany, where it is much cultivated, as it also is in the Low Countries and the north of France, where it is chiefly given to milch cows, for which it is well adapted on account of its possessing little of that acridity which is found in the turnip to affect butter and milk. It is taken up before the frost sets in, and stored like potatoes or turnips for winter use. Its habits and produce are similar to the Swedish turnip, the part of the plant resembling which is a swollen bulb at the top of the stem, which, when divested of leaves, may readily be mistaken for a Swedish turnip. Hares are so fond of it, that on farms where they abound its culture is found to be impracticable. Sir Thomas Tyrwhitt first introduced it into England from Germany.†

(1265.) Although the parsnip (*Pastinacea sativa edulis* of De Candolle) is too tender a root for general cultivation in this country, it deserves notice on account of its fattening properties when given to all domesticated animals. "The parsnip," says Don, "has been partially introduced of late years as a field-plant, and is nearly equal to the carrot in its product of saccharine and nutritive matter. Its culture as a field-plant has chiefly been confined to the island of Jersey, where it attains a large size, and is much esteemed for fattening cattle and pigs. It is considered rather more hardy than the carrot, and its produce is said to be greater. . . . The variety best suited for the field is the *large Jersey*. . . . In the fattening of cattle, it is found equal, if not superior, to the carrot, performing the business with as much expedition, and affording meat of exquisite flavour, and a highly juicy quality. The animals eat it with much greediness. It is reckoned that 30 perches, where the crop is good, will be sufficient to fatten an ox 3 or 4 years old, when perfectly lean, in the course of 3 months. They are given in the proportion of about 30 lb. weight morning, noon, and night, the large ones being split in 3 or 4 pieces, and a little hay supplied in the intervals of those periods. And when given to milch cows with a little hay, in the winter season, the butter is found to be of as fine a colour and as excellent a flavour as when feeding in the best pastures. Indeed, the result of experiment has shewn, that not only in neat cattle, but in the fattening of hogs and poultry, the animals become fat much sooner, and are more healthy, than when fed with any other root or vegetable; and that, besides, the meat is more sweet and delicious. The parsnip-leaves being more bulky than those of carrots, may be mown off before taking up the roots, and given to cows, oxen, or horses, by whom they will be greedily eaten."‡ The leaves may be greedily

* Don's General Dictionary of Botany and Gardening, vol. i. p. 229.

† Sinclair's Hortus Gramineus Woburnensis, p. 411; and Lawson's Agriculturists' Manual, p. 187.

‡ Don's General Dictionary of Botany and Gardening, vol. i. p. 229.

eaten when no other green food is presented as a choice to cattle; but I have no doubt that cattle will make very little progress towards condition, when using them. The weight of the largest parsnips grown in gardens in Scotland, varies from 10 ounces to 2 lb. each.*

(1266.) The carrot (*Daucus carrota sativa* of De Candolle) is raised in the fields in several parts of this country. The varieties most suited for field-culture are the large orange, Altringham, long red, and green top white. In giving a detailed statement of the general treatment of the carrot, Mr Burrows says, in regard to their use in winter, "I take up, in the last week of October, with 3-pronged graips, a sufficient quantity to have a store to last me out any considerable frost or snow that may happen in the winter months. The rest of the crop I leave in the ground, preferring them fresh out of the earth for both horses and bullocks. The carrots keep best in the ground, nor can the severest frosts do them any material injury. The first week in March, it is necessary to have the remaining part of the crop taken up, and the land cleared for barley. The carrots can either be laid in a heap, with a small quantity of straw covered over them, or they may be laid in some empty outhouse or barn, in heaps of many hundred bushels, provided they are put together dry. This latter circumstance it is indispensable to attend to; for if laid together in large heaps when wet, they will certainly sustain much injury. Such as I want to keep for the use of my horses until the month of May and June, in drawing over the heaps (which is necessary to be done the latter end of April, when the carrot begins to sprout at the crown very fast), I throw aside the healthy and most perfect roots, and have their crowns cut completely off and laid by themselves. By this means, carrots may be kept the month of June out in a high state of perfection."† When the ground is desired to be cleared for wheat, carrots should be taken up in autumn, and stored in the manner described for mangel würzel (1239), in a *dry* state, though with fewer precautions against the frost. Arthur Young gives the average produce of an acre of carrots in Suffolk at 350 bushels; but Mr Burrow's crops averaged upwards of 800 bushels, which, taking the bushel at 42 lb., will make the former crop 6 tons 11 cwt., and the latter 15 tons exactly. In the fields in Scotland, the Altringham carrot has been grown to $1\frac{1}{4}$ lb., and in gardens to $2\frac{1}{2}$ lb.; and a crop of the large orange carrot, manured with night-soil, has been raised by Mr Spiers of Calcreuch at the rate of 9 tons the acre,—probably the Scotch acre,—which is equal to 7 tons 1 cwt. the imperial.‡

(1267.) Varieties of the common potato (*Solanum tuberosum*) are also used in the feeding of cattle, but as the crop is of more importance as human food, I shall reserve the description of storing them until the proper season, in autumn, when they are removed from the ground. Meantime, I may mention that the varieties raised exclusively for cattle are the common yam, red yam, and ox-noble.

* Lawson's Agriculturists' Manual, p. 270.

† Communications to the Board of Agriculture, vol. vii. p. 72.

‡ Lawson's Agriculturists' Manual, p. 268-70.

32. OF THE FEEDING OF SHEEP ON TURNIPS IN WINTER.

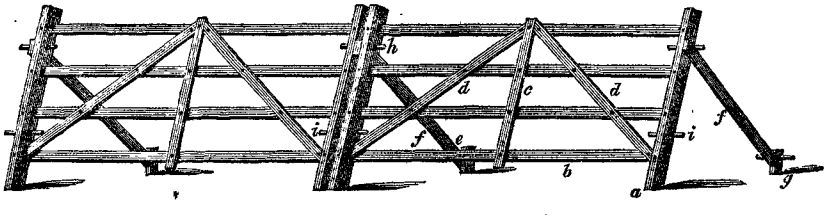
" Now, shepherds, to your helpless charge be kind,
Baffle the raging year, and fill their pens
With food at will; lodge them below the storm,
And watch them strict; for, from the bellowing east,
In this dire season, oft the whirlwind's wing
Sweeps up the burden of whole wintery plains
At one wide waft, and o'er the hapless flocks,
Hid in the hollow of two neighbouring hills,
The billowy tempest whelms."

THOMSON.

(1268.) Having prepared room on the turnip land for the sheep intended to be fattened upon turnips, by removing the proportion of the crop in the manner described above, that is, by drawing 2 rows and leaving 2 rows alternately, and having prepared that part of the field to be first occupied by the sheep, which will afford them shelter in case of need, the first thing to be afterwards done is to carry on carts the articles to the field requisite to form a temporary enclosure to confine the sheep within the ground allotted them. It is the duty of the shepherd to erect temporary enclosures, and as, in doing this, he requires but little assistance from other labourers, he bestows as much time daily upon it until finished as his avocations will allow.

(1269.) There are two means usually employed to enclose sheep upon turnips, namely, by *hurdles* made of wood, and by *nets* of twine. Of these I shall first speak of the *hurdle* or *flake*. Fig. 216 represents 2

Fig. 216.



HURDLES OR FLAKES SET FOR CONFINING SHEEP ON TURNIPS.

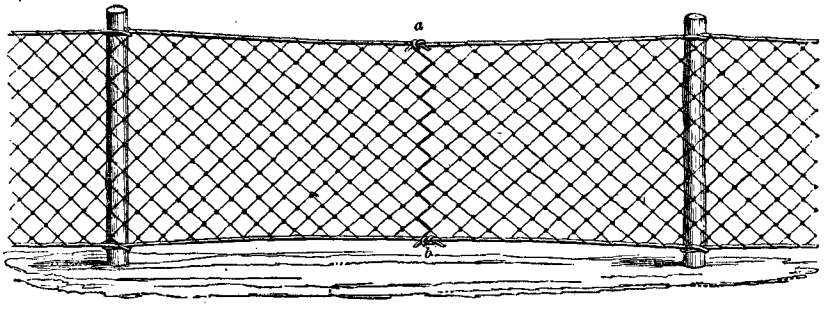
hurdles set as they should be. The mode of setting them is this; but in doing it, the shepherd requires the assistance of another person,—a field-worker will serve the purpose. The flakes are set down with the lower ends of their posts in the line of the intended fence. The first flake is then raised up by its upper rail, and the ends of the posts are

sunk a little into the ground with a spade, to give them a firm hold. The second flake is then raised up and let into the ground in the same way, both being held in that position by the assistant. One end of a stay *f* is then placed between the flakes near the tops of their posts, and these and the stay are made fast together by the insertion, through the holes in them, of the peg *h*. The peg *i* is then inserted through near the bottom of the same posts. The flakes are then inclined backwards away from the ground fenced, until their upper rail shall be 3 feet 9 inches above the ground. The stake *e* is driven into the ground by the wooden mallet, fig. 218, at such a point as, where the stay *f* is stretched out from the flakes at the above inclination, that a peg shall fasten stake and stay together, as seen at *g*. After the first two flakes are thus set, the operation is easier for the next, as flake is raised after flake, and fastened to the last standing one in the manner described, until the entire line is completed.

(1270.) Various objections can be urged against the use of flakes, the first being the inconvenience of carrying them from one part of a field to another in carts, and of their liability to breakage in consequence; as also the shepherd himself cannot set them up well and speedily without assistance, and even with that they require a good deal of time in setting up. They are also easily upset by a high wind blowing behind them; and when in use they almost require constant repair and replacing of pegs, stays, and stakes; though, when repaired and set carefully bye at the end of the season, they will last several years. The mode of making flakes, and their price, are mentioned below.

(1271.) The other method of enclosing sheep on turnips is with *nets*

Fig. 217.



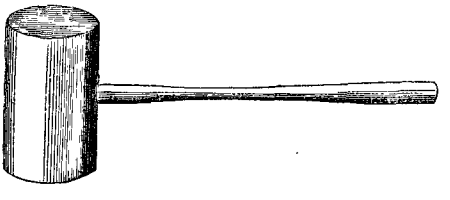
SHEEP-NET SET FOR CONFINING SHEEP ON TURNIPS.

made of twine of the requisite strength. These nets having square meshes when stretched upon the stakes, usually extend to 50 yards in length,

and stand 3½ feet in height. They are furnished with a rope along both sides passing through the outer meshes, which are called the "top" and "bottom rope" as the position of either may be at the time. These ropes are wound round the stakes by a peculiar sort of knot called the "shepherd's knot." The stakes are best formed of thinnings of ash-trees that have been planted very thick together and grown up long and small, and they should be 3 inches in diameter and 4 feet 9 inches long; allowing 9 inches of a hold in the ground, 3 inches between the ground and the bottom of the net, and 3 inches from the top of the net to the top of the stake; or they may be made of larch weedings, 4 inches in diameter and 4 feet 9 inches long; but every kind of wood of which they may be made should be seasoned with the bark on before being cut into stakes. They are pointed at one end with the axe, and that end should be chosen to be pointed which will make the stake stand in the same position as when it was growing in the tree, for its bark, it has been found, is then in the best state for repelling rain.

(1272.) A net is set in this way. If the ground is in its usual soft state, the stakes may simply be driven into the ground with a hardwood *mallet*, fig. 218, in the line fixed on for setting the net, at distances of 3 paces asunder. The wood of the apple-tree makes the best mallet, as not being apt to split. Should the soil be thin and the subsoil moderately hard, a hole sufficiently large for a stake may be made in the subsoil with the tramp-pick, fig. 37; but should the subsoil be so very hard as to require a larger hole to be made than what can easily be

Fig. 218.



THE SHEPHERD'S WOOD MALLET.

Fig. 219.

THE DRIVER.

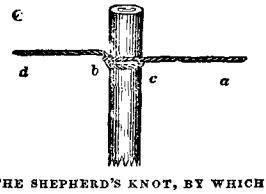
formed by the tramp-pick, or should the ground be so dry and hard as to require the use of any instrument at all, the most efficient one for the purpose is one called a *driver*, fig. 219. It is formed of a piece of pointed hard-wood, strongly shod with iron, and its upper end is protected by a strong ferrule of iron to prevent its splitting by the

strokes of the mallet. The stakes being thus driven so that their tops may not be less than 4 feet high, along as many sides of the enclosure as are required at the place to form a complete fence.

(1273.) A net is set in this manner. Being in a bundle, having been rolled up on the arms and fastened together by the spare ends of the top and bottom ropes, these are unloosened and tied to the stake that has been driven close to the fence, whatever that may be, and then the net is run out in hand towards the right as far as it will extend in a loose manner, on the side of the stakes facing the ground the sheep are to occupy. On coming to the next stake from the commencement, the bottom rope gets a turn to the left round the stake, and the top rope above it a similar turn round the same stake, so as to keep the leading coil of the rope uppermost. The bottom rope is then fastened with the shepherd's knot to the stake, 3 inches from the ground, and the top rope is fastened with a similar knot near the top of the stake, stretching the net even and upwards; and in this way the net is fastened to one stake after another until the whole of it is *set up*, as it is called, care being taken to make the top of the net run uniformly throughout its entire length.

(1274.) The shepherd's knot is made in this way. Let *a*, fig. 220, be the continuation of the rope which is fastened to the first stake, then press the second stake with the hand towards *a* or the fastened end, and at the same time tighten the turn round the stake with the other hand by taking a hold of the loose end of the rope *d*, and moving it so as to cause it to pass under *a* at *c*, and screwing it round the stake to *b*, where the elastic force of the stake will secure it tight under *a* at *b* when the stake is let go. The bottom rope is fastened first, to keep the net at the proper distance from the ground, and then the top rope is fastened to the same stake in the same manner. Proceed in this manner at each successive stake until the whole net is set up. A net may be thus set up either towards the right or the left as the starting point may be situate, but in proceeding in either direction care must be taken to pass the top and bottom ropes round the stakes, so as the leading coil of the rope is always uppermost towards the direction in which the net is to be set up. Thus, in fig. 220, the rope *d* was uppermost until it was passed under *a*, because the setting of the net in this case is from right to left, and it continues to be uppermost until it reach the next stake to the left. If both the cord and stake are dry, the knot may slip as soon

Fig. 220.



THE SHEPHERD'S KNOT, BY WHICH A NET IS FASTENED TO A STAKE.

as made, but if the part of the stake at *b* where the knot is fastened is wetted a little, it will make the rope keep its hold until the cord has acquired the set of the knot. With a new rope that is greasy, and a smooth stake, it is difficult for the knot to retain its hold even with the assistance of water.

(1275.) There are some precautions required in setting a net besides this of the ropes. If the net is new, the cords may be stretched as tight as you please, because they will stretch considerably; but if old, the least damp or rain afterwards will stretch them so as to cause them to break. If the net is at all in a damp state, it should be set very tight, because rain cannot make it tighter, and if not set very tight, the first dry weather will so slacken the cords as to loosen all the knots, and make the net slip down the stakes; but even if it should not be slackened to that extent, it will be so slackened as to shake about with the wind, and bag down and touch the ground. Such an occurrence will create the trouble to the shepherd of resetting the whole net, and the best way of avoiding this trouble is to have the nets in a dry state when they are set. In wet weather shepherds take the opportunity of a dry moment of setting a dry net in anticipation along a new break of turnips, and they also hang up wet nets to dry on the outside of the stakes away from the sheep. Nets should never be wound up in a wet state, even for a short time, as they will soon mould and rot.

(1276.) On commencing the setting of another net, its top and bottom ropes are fastened to those of the last net, and the ends of the nets themselves are brought together by interlacing the meshes of both with a piece of string, as at *a*, fig. 217. Here the knots in the top and bottom ropes are seen, and the twine interlacing the meshes are made to appear stronger than that of the net only to let it be perceived. Thus one net is set after another, until the whole intended area is enclosed. Where there is a turn in the line of nets in going from one side of the enclosure to another, as seen on the right side of fig. 226; if there is much of the net left at the turn, it should be brought down the next side; in which case the stake at the corner should be driven very securely down, as there will be a considerable strain upon it from the nets pulling from different directions, and this will especially be the case in damp weather. But the safer and perhaps better plan is to take a fresh net at the turn, and fasten it to a stake, and run on the other net in its own line until it is suspended either in setting or coiling it around the top of a stake. All surplus ends of nets should be carefully hung upon the back of the stakes when wet, to dry and get the air. Part of the nets will thus cross ridges, and part will run along a ridge. Where

they cross ridges that have been but once gathered-up, or ploughed crown-and-furrow, the bottom of the nets will be nearly close to the open furrows, but where they cross a gaw-cut in rather strong land, a stake or two should be made to lie upon the bottom rope to keep it down, for some sheep have a trick of creeping under the net, when they find a suitable opening; and where nets cross ridges which have been twice gathered-up, one stake should be driven at one side of the open-furrow, and another at the crown of the ridge, and the bottom rope will then run nearly parallel to the surface of the ground.

(1277.) In setting nets, in whatever position, care should be taken to keep each side of the enclosure in the same plane—that is, each side exactly in a straight line, and the surface of its nets perpendicular; and the different lines should meet at right angles to one another, so that every break of turnips occupied by the sheep should either be a rectangle or a square; because the strain upon the ends will then be equalized over the entire cords and stakes of each side, and no undue pressure exerted on any one stake. A shepherd who knows his business so as to pay attention to these particulars, will preserve his nets and stakes a much longer time in a serviceable state, than one who is ignorant or careless about them.

(1278.) The shepherd should always be provided with net-twine to mend any holes that may be made in the nets; and where they happen to be set across hare-roads, the hares will invariably keep their runs open; which being the case, it is much better to allow them to remain open, than in filling them up, to have them cut through daily.

(1279.) When flakes or nets have been set round the first break, the ground may be considered in a proper state for the reception of sheep; and the ground should be so prepared before the grass fails, that the sheep to be fattened may not in any degree lose the condition they have acquired on the grass; for you should always bear in mind that it is much easier to improve the condition of lean sheep that have never been fatter, than to regain the condition of those that have lost it. Much rather leave pastures a little rough, than risk the condition of sheep for the sake of eating it down. The rough pasture will be serviceable to the portion of the sheep-stock that are not to be fattened, such as ewes in lamb and aged tups. Let sheep, therefore, intended to be fattened be put on turnips as early as will maintain the condition they have acquired on the grass. By a *break* of turnips is meant that part of the crop which is being consumed by the sheep.

(1280.) As the tops of white turnips are long and luxuriant at the commencement of the season, the first break or enclosure should be

made smaller than those which succeed, that the sheep may not have too many tops at first on a change of food from grass to turnips, and which they will readily eat to excess, on account of their freshness and juiciness. Let the sheep fill themselves with turnips pretty well before taking them to the next break. The second break may be a little larger than the first, and the third may be of the proper size,—that is, contain a week's consumption of food. These considerations will cause the shepherd some trouble for two or three weeks in the beginning of the season; but they are trifling compared with the advantage derived from it by the sheep. Rather let him have the assistance of a field-worker to shift the nets, than neglect the precautions. When the tops wither in the course of the season, and one night of sharp frost may effect that, or after the sheep have been accustomed to the turnip, the danger is over. The danger to be apprehended is diarrhœa or severe looseness of the bowels, which is an unnatural state in regard to sheep, and they soon become emaciated by it, many sink under it, and none recover from such a relaxation of their system until after a considerable lapse of time.

(1281.) Another precaution to be used on this head, is, to avoid putting sheep on turnips for the first time in the early part of the day when they are hungry. The danger may be apprehended with tops in a dry state, but when they are wet by rain, or snow, or half-melted rime, they are most likely to do the harm. The afternoon, then, when they are full of grass, should be chosen to put the sheep on turnips, and they will immediately begin to pick the tops, but will not have time to injure themselves. Should the weather prove wet at first, and the ground be either somewhat too clayey or soft, and the sheep thereby find an uncomfortable lair, it would be advisable to allow them to rest in an adjoining grass field for a few nights until the ground becomes consolidated (which will soon take place) by their constant and repeated tramplings.

(1282.) Sheep when put on turnips are selected for the purpose. Ewes being at this season with young, whether as a flying or standing flock, are never, in Scotland, put on turnips in winter, but continue to occupy the pastures, part of which, if left on purpose in a rough state, will suffice to support them as long as the ground is free of snow. The reason why *great ewes*, as ewes in lamb are called, are never put on turnips is the chance of getting too fat, which if they do, they will produce small lambs and run great risk of being attacked by inflammatory complaints at the lambing time. Tups are most frequently put on turnips, especially tup hoggs, but they are never folded in the same part of the field as the feeding sheep, having a snug corner somewhere to themselves, or else the turnips are led to them in a sheltered part of a grass field. Young sheep, that is, lambs of the same year, are always put on turnips, whe-

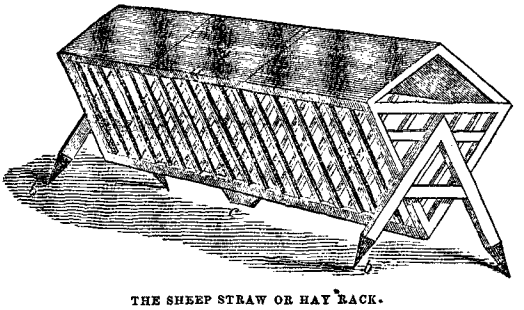
ther with the view of feeding them fat at once, or enlarging the size of their bone. Every year a certain number of old ewes, unfit for farther breeding from want of teeth, or means of supplying milk, are drafted out of the standing flock to make room for the same number of young females into the ewe flock; and are fattened off upon turnips. It sometimes happens that the castrated male lambs of last year, instead of being sold, have been grazed during the summer, and are fattened off the second season on turnips. All these classes of sheep, of different ages, may be mixed together and occupy the same break of turnips. It is seldom that the last class, namely, the lambs of last year, are kept on to the second year, but the draft ewes are always fed along with the young sheep, and they prove useful in breaking the turnips and eating up the picked shells. A mixture of old and young sheep are less useful to one another when turnips are cut by machines.

(1283.) Since I have had occasion to mention some of the classes of sheep, it may not be out of place here to make you acquainted with the technical names which they receive in respect of age and sex, and which I shall always employ when speaking of them in future. A newborn sheep is called a *lamb*, and retains that name until it is weaned from its mother and able to support itself. The name is modified according to the sex and condition of the animal; when a female, it is a *ewe-lamb*, when a male a *tup-lamb*, and the last name is changed to *hogg-lamb* when the creature undergoes emasculation. After a lamb has been weaned, until the first fleece is shorn from its back, it receives the name of *hogg*, which cognomen, like that of lamb, is modified according to the sex and condition of the animal, namely, a female is called a *ewe-hogg*, a male a *tup-hogg*, and a castrated male a *wether-hogg*. After the first fleece has been shorn another change is made in the nomenclature, the ewe-hogg then becomes a *gimmer*, the tupp-hogg a *dinmont* or *shearling-tup*, and the wether-hogg a *dinmont*, and these names are retained until the fleece is shorn the second time. After this operation another change is effected in all the names, the gimmer being then called a *ewe* if she is *in lamb*, but if she has failed being in lamb she is said to be a *tup-eill gimmer* or *barren gimmer*, and if she has never been put to the ram she gets the name of *yeld gimmer*. If a ewe who has borne lambs fails again to be in lamb, she is called a *tup-eill ewe* or *barren ewe*. After the ewe has ceased to give milk, or become dry, she is said to be a *yeld ewe*. The shearling tup is called a *2-shear tup* when the fleece has been taken off him the second time, and the dinmont commonly a *wether*, but more correctly a *2-shear wether*. After a ewe has been shorn three times she is called a *twinter ewe*, that is, a *two-winter ewe;* a tup that has been so treated is called a *3-shear tup;* and a wether still a

wether, or more correctly a 3-*shear wether*, which is an uncommon name among Leicester sheep, as the castrated sheep of that breed are rarely kept to so great an age. A ewe that has been four times shorn gets the name of a *three-winter ewe*, or *aged ewe;* a tup is called an *aged tup*, a name which he retains ever after, whatever his age, but they are seldom, except for special reasons, kept beyond this age; and the wether is now a *wether* properly so called. A *tup* and *ram* are synonymous terms. A ewe when she is removed from the breeding flock is called a *draft ewe*, whatever her age may be, and gimmers that are put aside as unfit for breeding from are called *draft gimmers*, and the lambs, dinmonts, or wethers, that are drafted out of the fat stock are called the *sheddings*, or *tails*, or *drafts*. In England a somewhat different nomenclature prevails. There sheep bear the name of *lamb* until 8 months old, after which they are called *ewe* and *wether teggs* until once clipped. Gimmers are called *theaves* until they bear the first lamb, when they are named *ewes of* 4-*teeth*, next year *ewes of* 6-*teeth*, and the year after *full-mouthed ewes*. Dinmonts are called *shear hoggs* until clipped, when they are 2-*shear wethers*, and ever after they are called *wethers*.

(1284.) When sheep are on turnips they are invariably supplied with dry fodder, hay or straw, hay being the most nutritious though most expensive; but sweet fresh oat-straw answers the purpose very well. The fodder is supplied to them in racks. There are various forms of straw-racks for sheep; some being placed so high that sheep can with difficulty reach the fodder; and others are mounted high on wheels. The form represented in fig. 221 I have found convenient, containing as much

Fig. 221.



THE SHEEP STRAW OR HAY RACK.

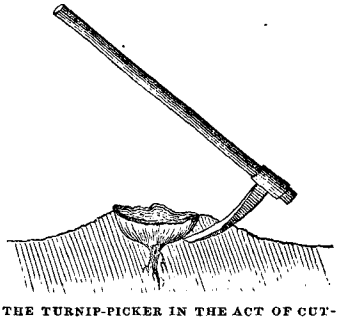
straw at a time as should be given, admitting the straw easily into it, being easily moved about, of easy access to the sheep, and being so near the ground as to form an excellent shelter. It is made of wood, is 9 feet in length, 4½ feet in height, and 3 feet in width, having a sparred rack with a double face below, which is covered with an angled roof of boards to throw off the rain. The rack is supported on 2 triangular-shaped

tressels *b*, shod with iron at the points, which are pushed into the ground, and act as stays against the effects of the wind from either side. The billet *c*, fixed on the under or acute edge of the rack, rests upon the ground, and, in common with the feet, supports it from bending down in the middle. The lid *a* is opened on hinges when the fodder is put into the rack. There should at least be 2 such racks in use; because when set at an angle to each other against the weather point, the space embraced between them forms an excellent shelter for a considerable number of sheep. (Fig. 226.) Such a rack is easily moved about by 2 persons, and their position should be changed according to a change of wind indicative of storm.

(1285.) It is the duty of the shepherd to supply these racks with fodder, and one or all of them may require replenishment daily. This he effects by carrying a bundle of fodder at any time he visits the sheep. When carts are removing turnips direct from the field, they carry out the bundles; but it is the duty of the shepherd to have them ready for the carters in the straw-barn or hay-house. For shelter alone the racks should be kept full of fodder. Fodder is required more at one time than another, in keen sharp weather the sheep eat it greedily, and when turnips are frozen they will have recourse to it to satisfy hunger, and after eating succulent tops they like dry fodder. In rainy, or in soft muggy weather, sheep eat fodder with little relish; but it has been remarked that they eat it steadily and late, and seek shelter near the racks prior to a coming storm of wind and rain or snow; in fine weather, on the other hand, they select a lair in the more exposed part of their break.

(1286.) Until of late years sheep were allowed to help themselves to turnips in the early part of the season; and in consuming them the tops were first eaten, and then the bulbs were scooped out as far as the ground would permit. When a large proportion of the turnips of the break were thus eaten, the *shells*, as the bottom part fast in the ground is called, were picked out of the ground with an instrument made for the purpose. Its name is a *turnip-picker*, and the mode of using it may be seen in fig. 222. Its handle is 4 feet long, and blade 10 inches, including the eye for the handle. By its mode of action, you will see that the tap-root of the turnip is cut through and the shell separated from the ground at one stroke. A very common form of these pickers is with

Fig. 222.



THE TURNIP-PICKER IN THE ACT OF CUTTING OFF THE TAP-ROOT AND PULLING UP THE SHELL OF THE TURNIP.

the mouth cleft in two, between which cleft the tap-root is embraced, and the shell and root are pulled up together. It is found, however, that the tap-root contains an acrid juice detrimental to the stomach of sheep, so that the better plan is to cut it off and leave it on the ground

Fig. 223.

THE BEST FORM OF TURNIP-PICKER.

Fig. 224.

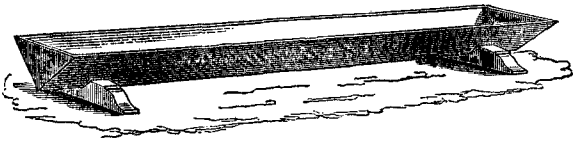
OBJECTIONABLE FORM OF TURNIP-PICKER.

to rot. The best form of blade may be seen in fig. 223; and fig. 224 shews the objectionable form of the same instrument.

(1287.) Only half of the ground occupied by the shells should be picked up at one time, by removing every alternate double row of them, in order to make the sheep spread over a greater space while consuming them. When the ground is dry, the shells should be pretty clean eaten up before a new break of turnips is formed; but a few being left, the sheep will come over the ground again and eat them up, though in a shrivelled state, especially in frost, when they are sweeter and softer than turnips.

(1288.) But the more recent and better plan of serving turnips to sheep, and it should be universally adopted, is to cut them into small pieces with a turnip-slicer into troughs conveniently placed for use, while at the same time the sheep have liberty to eat the turnips themselves. A convenient and expeditious form of turnip-slicer is described below at fig. 252, which description you should peruse at once; and a simple form of turnip-trough is here represented by fig. 225. It is

Fig. 225.



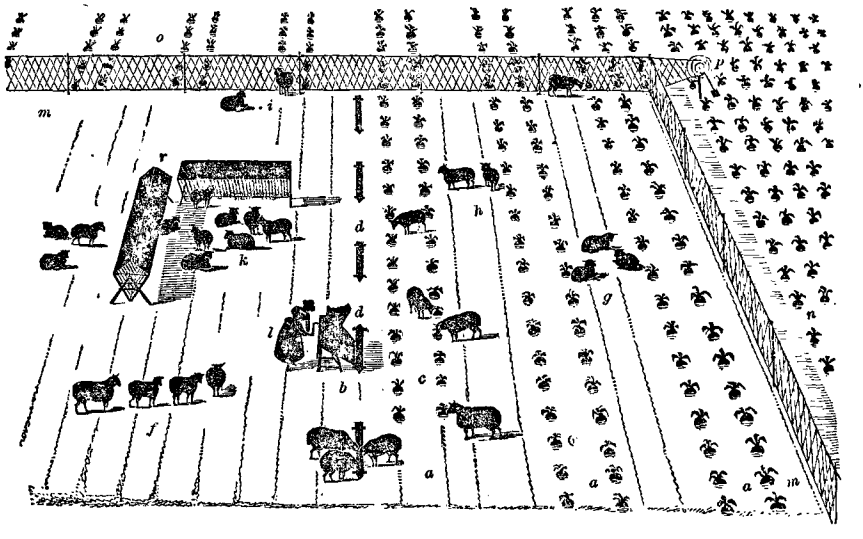
THE TURNIP-TROUGH FOR SHEEP-FEEDING.

8 feet long, and made acute at the bottom, for the more easy seizure of the pieces of turnip by the mouths of the sheep, by nailing two boards together upon the two triangular-shaped ends, and placing it upon bil-

lets for feet. The troughs are set in a line along the outside 2 rows of turnips about to be pulled. The turnip-cutter is wheeled to each trough successively by the field-worker, who works the handle, and its hopper is filled by another worker, who tops and tails the turnips. The sheep range themselves on either side of the trough.

(1289.) I have constructed fig. 226 to give you a bird's-eye view of the manner in which a turnip-field should be fitted up for sheep. There

Fig. 226.



THE MODE OF OCCUPYING TURNIP-LAND WITH SHEEP.

are, in the first place, the turnips themselves *a*, of which half have been drawn by pulling 2 drills and leaving 2 alternately. The ground upon which they are growing is represented partly bare, because they are supposed to have been pulled up in the progress of the turnip-cutter advancing from one side of the break to the other; and it constitutes the break. As matters are represented, the turnip-slicer *b* is proceeding up beside the 2 drills *c*, and depositing the cut turnips into one of the small troughs *d*, out of another of which some of the sheep are eating, whilst others are helping themselves from the bulbs in the drills *c*. The sheep are represented scattered over the ground as they are usually seen, some following one another in a string *f* towards the place where their food is preparing for them, whilst others *g* are lying resting regardless of food. Some, *h*, are standing, as if meditating what next to do, and others, *i*, examining the structure of the nets. Some nibble at the dry fodder in the racks *r*, whilst, *k*, a group lie under their shelter. The field-worker *l* is slicing

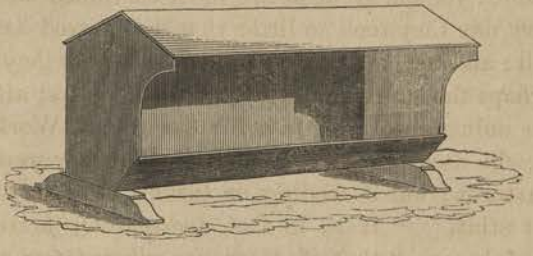
the turnips with the machine. Such are the usual occupations of sheep when they have abundance of food at their command. The nets *m* are represented as inclosing two sides of the break, the other two sides being supposed to be composed of the fences of the field, and not represented. The turnips *n*, to the right of the nets, appear undrawn, while those *o*, above the nets are stripped, indicating that the progress of the breaks at this time is upwards towards the top of the field, in a line with the direction of the drills, and, of course, with that of the ridges; and this part of the plan is not a matter of indifference, because the breaks should so succeed one another in their passage across the field, as that the land, when cleared of turnips, may be ploughed from end to end and ridged up, if desired. In a large field, which engages the sheep for a considerable part of the season, the land is ploughed as each stretch of breaks is cleared, in order to preserve the virtue of the manure, and this is of more importance in a large than in a small field, over which a large number of sheep will soon pass over. In ploughing up land, however, with this intent, care should be taken not to deprive the sheep of any natural shelter they have enjoyed; and to secure this to them as long as practicable, the breaks should be so arranged as to make those first formed along the lowest and most sheltered part of the field, so that the sheep could resort at the bottom of the set of breaks they are occupying, after the first set had been given up and ploughed to the top of the field, and so on in succession. Such an arrangement requires more consideration than at first sight may appear; and its neglect may much inconvenience the sheep for want of shelter; and shelter to sheep in winter does not merely imply protection from unusual inclemency of the weather for a night or two, but also preservation of the fleece, and comfort to the flock throughout the season. The remainder of the net along the upper part of the break is represented coiled round the top of a stake at *p*, and there also the mallet and driver await their use.

(1290.) I have already stated, that *tups* or *rams* are fed on turnips in a separate division from the feeding sheep. Some apportion them in a space in the same, whilst others give them a break in another field; but I would prefer giving tups turnips in a small grass paddock, and cutting them with the small lever turnip-slicer represented in fig. 246. and described minutely below. Where the lot of tups is large, say 40 or 50, it may create, it is true, more trouble to fetch their turnips to them than to enclose them on turnips, but this consideration should be always borne in mind, in regard to tups, that whenever they and female sheep become aware of the presence of each other in the same field, and even in contiguous fields, neither party will rest to feed. The air will carry the

scent of their bodies to each other, and whenever any of the females shew a tendency towards coming into season, the scent of the males confirms it, and, becoming restless themselves, they have a tendency to render the rest of the flock so also. And if tups are in a separate fold by themselves, away from the rest of the sheep, they cause as much trouble to the shepherd in visiting them there as a larger flock; whereas, were they near home in a grass paddock, he could visit them frequently in going and coming to his house at his hours of repast.

(1291.) Sheep are sometimes assisted in their feeding on turnips with other substances, such as oil-cake and corn. Either of them is administered in a covered box, to protect it from injury from weather. Such a box is represented in fig. 227, the construction of which requires no ex-

Fig. 227.



THE OIL-CAKE OR CORN BOX FOR FEEDING SHEEP.

planation. I have never had any experience of feeding sheep on oil-cake or corn, having mostly farmed turnip-land, upon which sheep never failed to become abundantly fat without any adventitious aid. On deaf and clay soils, however, oil-cake may prove beneficial; and it may be presented in these boxes to sheep on grass in winter as their entire food. Oil-cake has the effect of keeping the dung of sheep in a moist state. It is supplied them in a bruised state, partly in powder, and partly in bits, as it falls from the oil-cake crusher, a convenient machine, the construction and operation of which will be described when treating of the feeding of cattle; I believe there is little use of measuring the quantity of oil-cake to sheep, even when on turnips, as they will eat it when inclined, and some sheep eat it more heartily than others. The discriminating choice of food manifested by sheep is a valuable hint, in fattening them, to supply them with different kinds of food, such as oil-cake, corn, hay, straw, and turnips, at one and the same time, that every sheep may take his choice daily; but in case such a mode of feeding may be costly, it is worth while to try experiments on the subject, in order to ascertain whether, when a number of articles are presented at the same

time to sheep for their choice, less of the most costly kind is not proportionally consumed than when supplied separately. On this principle corn may be put in one box, and oil-cake in another, and so of other substances; and although it is an indubitable fact, that sheep will feed quite fat upon turnips alone with fodder on turnip-soil, yet they may become sooner ripe upon mixed than simple food; and the time thus gained may more than compensate (or at least compensate) for the cost of the various materials employed in feeding.

(1292.) *Salt* has been frequently given to sheep on turnips, but with what advantage I have never satisfactorily learned. I have given them it, and the eagerness with which they followed the shepherd when he came at the stated hour to lay down small quantities here and there over the break, upon flat stones, and the relish with which they enjoyed it was very remarkable; yet the great desire for it continued but a short time, and then every day they took so little that it appeared as if they were trifling with it; and hence I could perceive no benefit they derived from its use. Perhaps the cultivator who paid the greatest attention to the use of salt to animals was the late Mr Curwen, of Workington Hall, Cumberland, who used to give from 2 to 4 ounces per week to sheep, if fed on dry pastures; but if feeding on turnips or rape, they were supplied without stint. "It is, in fact, *indisputably proved*," says Mr Cuthbert W. Johnson, "that if *sheep are allowed free access to salt, they will never be subject to the disease called the rot.* Is not this a fact worthy of a farmer's earliest, most zealous attention? Some recent experiments also lead me even to hope that I shall one day or other be able to prove it to be a *cure* for this devastating disease. I have room but for one fact: Mr Rusher, of Stanley, in Gloucestershire, in the autumn of 1828, purchased, for a mere trifle, 20 sheep, *decidedly rotten*, and gave each of them, for some weeks, 1 ounce of salt every morning; 2 only died during the winter; the surviving 18 were *cured*, and have now, says my informant, lambs by their sides." *

(1293.) There are some inconveniences attending the feeding of sheep on turnips *in winter*, which necessarily you should be made aware of. A heavy rain may fall for some days, and render the land quite soft and poachy, though it had been previously thoroughly drained, or even naturally dry. As the wet will, in such a case, soon subside, the removal of the sheep for a night and day to an old grass-field will give the land time to become firm; and a small quantity of oil-cake will suffice to sup-

* Johnson's Observations on the Employment of Salt, p. 12.

port the sheep all the time they will be in the grass-field. A very heavy rain may fall in a day, and inundate the lower end of the field with water, which may take some days to subside. The best way of preventing the sheep approaching the inundated part is to fence it off with a net. A fall of snow, accompanied with wind, may cover the sheltered part of the field, and leave the turnips bare only in the most exposed. In this case, the sheep must feed in the exposed part, and the racks placed there for shelter. But the snow may fall heavily, and lie deep over the whole field, and cover every turnip out of reach. Two expedients only present themselves in such a case; the one is to cast the snow from the drills containing the turnips, and pile it upon those which have been stripped. This task cannot be performed by the shepherd alone, or by the field-workers. The ploughmen must bring their stable-shovels, fig. 149 or fig. 176, and clear the turnips; but in doing this in severe frost, too many turnips should not be exposed at one time, in case they become frosted, which they are apt to be when exposed suddenly to frost from under snow. The advantage of casting the snow is, that it gives the sheep an immediate access to the turnips; but a disadvantage attends it when the snow lies for a considerable time, all the manure being left by the sheep in the channels cut out of the snow, and, of course, none in those parts upon which the snow has been piled. The best plan to pursue at first, under the circumstances, is, in my opinion, to adopt the other expedient alluded to above; namely, to give the sheep oil-cake in the troughs, fig. 227, for a time, in a sheltered place of the field, until it is seen whether the snow is likely soon to disappear; and should it lie longer than afford time to consume the turnips, then the first expedient of casting off the snow may be resorted to at once, and its disadvantages submitted to. In the great fall of snow, in spring 1823, my turnip-field was covered over 4 feet deep. Having no oil-cake, and finding it impossible to remove the sheep, the snow was cast in trenches, in which they soon learned to accommodate one another, and all throve apace. A fresh fall of snow a few days after came from the opposite quarter, and covered up the trenches, which had to be cleared out again. The snow continued upon the ground until the end of April, and as there was no time after that to put manure on the land which had been covered with piled up snow,—and, indeed, its soft state rendered the operation impracticable,—the succeeding crop of barley grew in strips corresponding to the trenches. Even a supply of oil-cake would not, in this case, have superseded the trenching of the snow, to get the turnips eaten in time for the barley-seed.

(1294.) Whilst young sheep and tups are thus provided with turnips during winter, the *ewes in lamb* find food on the older grass, which, for their sakes, should not be eaten too bare in autumn. Where pastures are very bare, or when snow covers the ground, they should either have a few turnips thrown down to them upon the snow, or, what is better, clover-hay given them in a sheltered situation. The best hay for this purpose is of broad or red clover, and next meadow-hay; but as you can only give the kind you happen to have, much rather give them turnips than hay that has been heated or wetted, or is moulded, as in either of those states it has a strong tendency to engender diseases in sheep, such as consumption of the lungs and rot of the liver; and in regard to great ewes, it is apt to make them cast lamb. If turnips cannot be had, and the hay bad, give them sheaves of oats, or clean oats in troughs, or oil-cake; but whatever extraneous food is given, do not supply it in such quantity as to fatten the ewes, but only to keep them in fair condition. In the severe snow-storm of 1823, I put my ewes into an old Scots-fir plantation, into which only a small quantity of snow had penetrated, and there supplied them with hay laid on the snow around each tree. A precaution is requisite in using a Scots-fir plantation in snow for sheep; its branches intercepting the snow in its fall to the ground are apt to be broken by its weight, and fall upon the sheep and kill them; and in my case, a ewe was killed on the spot by this cause. The branches should therefore be cleared of the snow around where the sheep are to lodge by shaking them with poles or long forks, assisted by ladders if the case requires it. In driving ewes, heavy with lamb, through deep snow to a place of shelter, plenty of time should be given them to creep along, in case they should overreach themselves, and the exertion thereby cause them to cast lamb.

(1295.) In some parts of Scotland, and more generally in England, rape as well as turnips are grown for winter food for sheep. The rape (*Brassica rapus oleifera* of De Candolle), cultivated in this country, is distinguished from the colsat of the Continent by the smoothness of its leaves. It has been cultivated for the fattening of sheep in winter from time immemorial. The green leaves, as food for sheep, are scarcely surpassed by any other vegetable, in so far as respects its nutritious properties; but in quantity it is inferior both to turnips and cabbages. Its haulm may be used as hay with nearly as much avidity as cut straw.* The consumption of rape by sheep should be conducted in exactly the same manner as that of turnips. In England, that intended for sheep

* Don's General Dictionary of Botany and Gardening, vol. i. p. 245.

is sown broadcast and very thick, in which state it is certainly very suitable for them. In Scotland, it is raised in drills like turnips; and although not so conveniently placed for sheep as the broadcast, the top leaves being somewhat beyond their reach from the bottom of the drill, yet this form permits every cleansing process of the land during summer, and thus renders the culture of rape as ameliorating a crop for land as any of the other green crops raised for the purpose. It is acknowledged on all hands, that, for raising seed for oil, the drill form of culture is far the best.

(1296.) Every kind of sheep, of whatever breed, when kept in the low country, should be treated in winter in the way described above, though the remarks there are meant to apply to the peculiar management of Leicester sheep, which is the usual breed cultivated where sheep form an integral part of the mixed husbandry. Where a Leicester flock is so kept, the ewes are regarded as a *standing flock;* that is, they have themselves been bred upon the farm upon which they are supported, and are used as breeders, until considered no longer profitable, when they are fed off. But on many lowland farms, the mixed husbandry is only practised to a partial extent, no flock of ewes being kept for breeding, and only wethers, intended to fatten on turnips, are bought in on purpose. Some farmers, instead of wethers, buy old ewes, dinmonts, or lambs. When wethers are bought, the breeds generally selected for the purpose are Cheviots and Black-faced from the mountains, where they are bred, and where large standing flocks of ewes are kept for the purpose of supplying the demand for lambs. Turnip-sheep are thus easily obtained at fairs in autumn; but where certain stocks have acquired a good name, purchasers go to the spot, and buy them direct from the breeders.

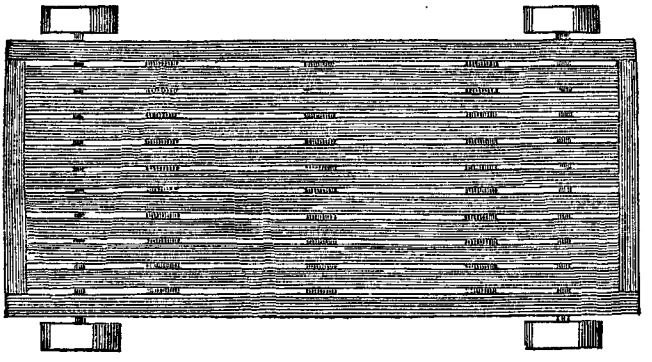
(1297.) Sheep on turnips have little shelter afforded them but what the fences of the field can give. In some cases, this is quite sufficient; but in others, it is inadequate. Of late years, the subject of shelter has attracted attention, and artificial means have been suggested, consisting of various devices involving different degrees of cost, not merely for protection against sudden outbreaks of weather, but with the view of gradually improving the condition of sheep, both in carcass and wool. It is a natural expectation, that a fat carcass should produce more wool, and constant shelter improve its quality.

(1298.) One plan for shelter and comfort, a slight remove from the usual practice, was first tried by Mr Hunter of Tynefield, in East Lothian, in 1809, by littering the break occupied by the sheep in the field with straw, and supplying them with turnips upon it. In this way he littered 300 sheep upon 25 acres of turnips, which afforded 36 tons the acre, with the straw of 60 acres of wheat, weighing 1 ton the acre imperial. The sheep were thus treated 5 months on the ground, and fetched 2s. a head more than those treated in the usual manner. This increase of price is an advantage; but it is not all advantage, as the trouble of leading, at intervals, 60 tons of straw to the field; of leading the same, in the shape of manure, from that field to another; and of carrying the turnips from the drills to the fold, should be deducted from it. When turnips are laid upon straw, sheep cannot bite them easily; and this is an objection to laying down whole turnips to sheep on grass, instead of cutting them

with a turnip-slicer; and amongst damp litter, sheep almost invariably contract foot-rot, as 7 of Mr Hunter's did.*

(1299.) Another plan of affording shelter to sheep on turnips is that of movable sheds to lie in. Fig. 228 gives a floor-plan of such a shed, 15 feet

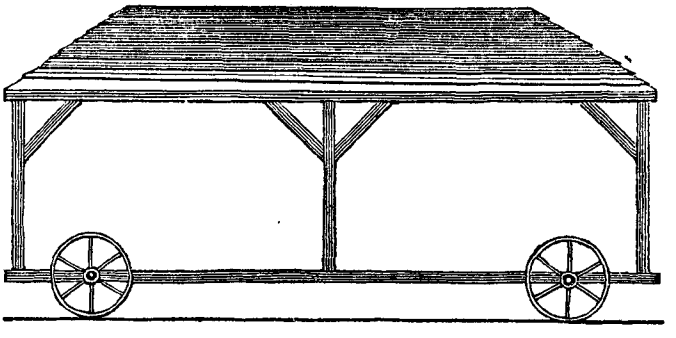
Fig. 228.



THE FLOOR OF A MOVABLE SHED FOR SHEEP ON TURNIPS.

long 7 feet wide, with an opening of $\frac{3}{8}$ of an inch between the floor-deals. The floor-frame rests on 2 axles of iron supported upon 4 iron wheels, 1 foot diameter, which raise it 6 inches above the ground. Fig. 229 gives a side-elevation of the shed, with the form of the roof, made of deals, lapping over

Fig. 229.



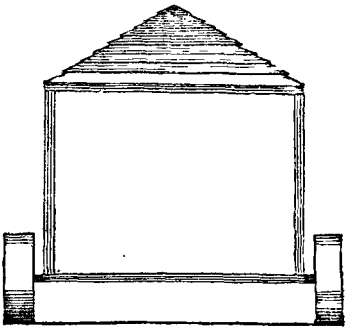
THE SIDE-ELEVATION OF A MOVABLE SHED FOR SHEEP ON TURNIPS.

each other, and elevated 5 feet above the floor; and fig. 230 is an end-elevation of the same. One side and both ends, when the shed is in use, could be boarded in the quarter from which the wind comes; and if the boards are fastened dead, the shed should be wheeled round to suit the wind; but if boarding is considered too expensive a mode of fitting up such sheds, hurdles clad with

* Sinclair's Account of the Husbandry of Scotland, vol. ii. Appendix, p. 47.

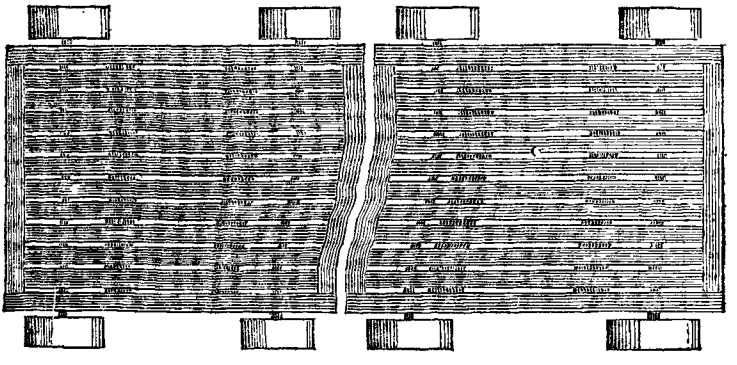
thin slabs, or wattled with straw or willow against the ends and side, might answer the same purpose. A horse is required to wheel such a shed to any distance. A shed of the above dimensions might accommodate about a score of sheep, and its cost is said to be L.4. But should this construction be considered too unwieldy, the shed could be made of two pieces of half the size, which would easily be moved about by people, and when placed together on end, would form an entire shed of the proper dimensions. Thus, fig. 231 represents two short floors placed together on 8 wheels; and fig. 232 a side-elevation and roof of two half-sheds, mounted on wheels, set together. The scale attached to fig. 232 gives the relative proportions of every part. The cost of 2 half-sheds will of course be more than a whole one. Whether any one will incur the cost

Fig. 230.



THE END-ELEVATION OF A MOVABLE SHED FOR SHEEP ON TURNIPS.

Fig. 231.



THE FLOOR OF TWO SHORT MOVABLE SHEDS FOR SHEEP ON TURNIPS.

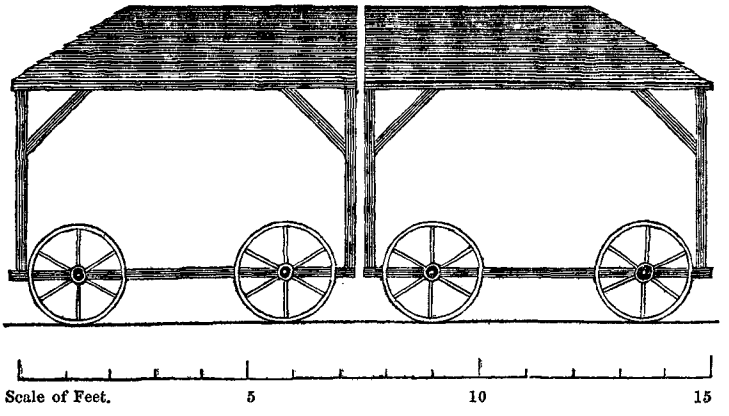
of sheltering sheep on turnips in such sheds, is, I conceive, questionable; and it might be some time ere sheep would be induced to enter them.*

(1300.) A third plan is to erect sheds and courts at the steading, to be littered when required, and the sheep daily supplied with cut turnips. This plan, as I conceive, would afford more shelter and protection than by putting down litter, or erecting movable sheds in the field. I remember of seeing, more than 20 years ago, the courts and sheds erected at his steading by the late Mr Webster of Balruddery, Forfarshire; so that the recent practice and suggestions on the subject by English sheep-feeders possess at least no novelty. The results of Mr Webster's experiments, I believe, were not very encouraging. Mr Childers, M.P. for Malton, fed 40 Leicester wether-hoggs on turnips, 20 in the field

* Quarterly Journal of Agriculture, vol. xi. p. 27-30.

and 20 in a shed. The shed consisted of a thatched erection of rough deals, having a floor of slabs raised 18 inches above the ground, with a small court belonging to it. The boarded floor was swept every day, and fresh straw put over the court after every shower of rain. The sheep were divided into as

Fig. 232.



THE SIDE-ELEVATION OF TWO SHORT MOVABLE SHEDS FOR SHEEP ON TURNIPS.

equal lots as could be drawn, the score to be fed in the shed weighing 183 stones 3 lb., and those in the field 184 stones 4 lb. Each lot got as many *cut* turnips as they could eat, which amounted to 27 stones every day; 10 lb. of linseed-cake, or ½ lb. to each sheep, per day; ½ pint of barley to each sheep; and a little hay, and a constant supply of salt. They were fed from 1st January to 1st April; and, on the fourth week, the hoggs in the shed eat 3 stones fewer turnips every day; in the ninth week, 2 stones still fewer, and of linseed-cake 3 lb. per day. The results were these:

Date.	20 shed hoggs.	Increase.	20 field hoggs.	Increase.
	St. lb.	St. lb.	St. lb.	St. lb.
January 1, ...	183 3		184 4	
February 1, ...	205 0	21 11	199 8	15 4
March 1, ...	215 10	10 10	208 2	8 8
April 1, ...	239 9	23 13	220 12	12 10
Total increase, .		56 6		36 8

"Consequently," says Mr Childers, "the sheep in the shed, though they consumed nearly ⅛ less food, have made ⅓ greater progress." * Thus, in 4 months, the shed-fed hoggs gained about 1 stone a-head more than those in the field, and were worth 7s. a-head more. This experiment of shed-feeding corroborates the ordinary experience in the progress of fattening sheep; namely, that the great-

* Journal of the Royal Agricultural Society of England, vol. i. p. 169.

est progress is made at the beginning and end of the season. In the beginning, the fat is laid on in the inside, to fill up ; and at the end, it is laid on on the outside, after the acquirement of muscle in the intermediate period.

(1301.) Lord Western pursues the plan of shed-feeding his Anglo-merino sheep, to the extent of confining them all the year round.* His folding-yards are spacious, and surrounded by sheds, which are only 10 feet wide, and 6 or 7 feet high, built, in the cheapest manner, of timber that would otherwise be burnt. The yards are well littered, and to a considerable depth, and they never heat. After three years' experience, his lordship is "decidedly of opinion, that the fatting stock thrive quicker, and the sheep with their lambs also do better than out of doors." Turnips, cabbages, and salt, constitute their food.*

(1302.) Similar experiments have been tried in Scotland with success. Mr Wilkin, Tinwald Downs, Dumfriesshire, fed 20 cross-bred Cheviot and Leicester hoggs in courts and sheds, on turnips, grass, and oil-cake, and their increased value over others in the field was estimated at from 22s. to 25s.; and Mr John MacBryde, Belkar, fed both Leicester and Cheviot wethers in *stalls* on turnips, rice, sago, sugar, and linseed-oil, and realized 7s. a-head more than from those fed in the field.† But in estimating the advantages derived from shed-feeding, the trouble occasioned in bringing the turnips from, and taking the manure to the field, should always be borne in mind. But should the plan leave no profit, yet if it improve the quality of the wool in its most essential particulars, it is worthy of consideration.

(1303.) Sheep are not fed on turnips on every kind of farm. Carse-farms are unsuited to this kind of stock, and where turnips can be raised on them, cattle would be more conveniently fed. There being, however, abundance of straw on clay-farms, sheep might be fed in small courts and sheds at the steading on oil-cake, or any other succedaneum for turnips.

(1304.) On farms in the neighbourhood of *large* towns, whence a supply of manure is obtained at all times, turnips are not eaten off with sheep; but on those near small towns, they are so employed to manure the land. They are bought in for the purpose, and consist of Cheviot or Black-faced wethers, or Leicester hoggs, or draft ewes, which, if young, feed more quickly than wethers of the same age.

(1305.) On dairy-farms there is as little use for sheep as near towns, except a few wethers to eat off part of the turnips that may have been raised with bone-dust, or any other specific manure, in lieu of farm-yard dung.

(1306.) On pastoral farms, sheep are not fattened on turnips; but their treatment in winter possesses exciting interest. There are *two kinds of pastoral* farms, and as this is the first opportunity I have had of considering the peculiarities of their management, I shall here make some general remarks on their constitution and fitness for rearing sheep.

(1307.) The first thing that strikes you on examining a pastoral country is the *entire want of shelter*. After being accustomed to see enclosed and protected fields in the low country, the winding valleys and round-backed hills of a pastoral one appear, by comparison, naked and bleak. You are not surprised to find bare mountain-tops, and exposed slopes in an alpine country, because

* Mark-Lane Express. 16th December 1839.

† Quarterly Journal of Agriculture, vol. xi. p. 128.

you scarcely conceive it practicable for man to enclose and shelter elevated mountains; but amongst green hills and narrow glens, where no natural obstacles to the formation of shelter seem to exist, but, on the contrary, whose beautiful outlines indicate sites for plantations that would delight the eye of taste, independent of their utility as shelter to their owner's habitation; and he, having experienced their utility in that respect, could not refuse similar comfort to the dumb and patient creatures dependent on his bounty. Hence, the hurricane that a planter arrests in its progress towards his own dwelling, ceases at the same time to annoy the peace of his flocks and herds. The chief difficulty of forming shelter by planting is the expense of enclosing it; for as to the value of trees from a nursery, it is a trifle compared to the advantage derived from the shelter where they grow; and yet, in a mountainous country, there is no want of materials for enclosing, no want of rock to produce stones for building rough but substantial stone-dykes; labour is but required to remove and put them together, and as a simple means of their removal, it is surprising what a quantity a couple of men will quarry, and a couple of single-horse carts will convey, in the course of a summer. The carriage, too, in every instance, could be made downhill, fresh rock being accessible at a higher elevation as the building proceeds upwards.

(1308.) Suppose a hill-farm containing 4 square miles, or 2560 acres, were enclosed with a ring-fence of planting of at least 60 yards in width, the ground occupied by it will amount to 174 acres. A 6-feet stone wall round the inside of the planting will extend to 13,600 roods of 6 yards, which, at 6s. 6d. per rood, will cost L.612. But the sheltered 2386 acres will be worth more to the tenant, and of course to the landlord, than the entire 2560 acres unsheltered would ever have been; whilst the proprietor will have the value of the wood for the cost of fencing. Besides, it should be borne in mind by the proprietor, that planting as a ring-fence to one farm, shelters one side of 4 other farms of the same size, which is an inducement to extend the benefits of shelter, and these, moreover, can be afforded on a large scale at a cheaper cost than on a small; so much so, that, were neighbouring proprietors to undertake simultaneously the sheltering of their farms on a systematic plan, not only would warmth be imparted over a wide extent of country, but efficient fencing would be accomplished along march-fences at half the cost to each proprietor.

(1309.) Low pastoral farms should be stocked with *Cheviot*, and high with the more hardy *Black-faced*, sometimes called the Heath and Mountain Sheep; and although the general treatment of both breeds are nearly alike, yet their respective farms are laid out in a different manner. A Cheviot sheep-farm contains from 500 to 2000 sheep; that which maintains from 500 to 1000 is perhaps the highest rented, being within the reach of the capital of many farmers; and one that maintains from 1000 to 2000 is perhaps the most pleasant to possess, and, if it have arable land attached to it, will afford pretty good employment to the farmer, though with good shepherds under him, and no arable farm, he could manage the concerns of 6000 sheep as easily as those of 500. A shepherd to every 600 Cheviot sheep is considered a fair allowance, where the ground is not very difficult to traverse, and it may be held as a fair stent to put 1000 sheep on every 1200 acres imperial.*

* Little's Practical Observations on Mountain Sheep, p. 10.

(1310.) Every Cheviot sheep-farm should have arable land within it, to supply turnips and hay to the stock, and provision to the people who inhabit it. It is true, that all the necessaries, as well as the luxuries, of life, may be purchased; but no dweller in the country will hesitate a moment to choose the alternative of raising the necessaries of life and having them at command, to going perhaps many miles to purchase the most trivial article of domestic use. It is not easy to determine the proportion which arable land should bear to pastoral, to supply the requisite articles of provision; but perhaps 2 acres arable to every 20 breeding ewes the pasture maintains may supply all necessaries. Taking this ratio as a basis of calculation, a pastoral farm maintaining 1000 ewes, a medium number, would require 100 acres of arable land, which would be laboured by 2 pair of horses, on a 4-course shift; because *pasture* not being required on the *arable* portion of the farm, new grass will be its substitute. The farm will thus be divided into 25 acres of green crops, 25 acres of corn after them, 25 acres of sown grasses, and 25 acres of oats after the grass. Manure will be required for 25 acres of green crop, which will partly be supplied by the 100 acres of straw; by bone dust; and by sheep on turnips after bone-dust. To render the straw into manure there are 4 horses; cows of the farmer, the shepherd, and ploughmen; with perhaps a few stirks, the offspring of the cows, and a young colt or two, in the farm-yard. The arable land should have a ring-fence of thorn, if the situation will admit of growth or of stone.

(1311.) The *steading for such a farm* may be of the form of fig. 28, containing a 4-horse thrashing-mill, driven by water if possible, by horses by necessity; a corn-barn, straw-barn, chaff-house, stable, byre, cart-shed, wool-room, and implement-room for the shepherd's stores.

(1312.) The pasture division of the farm should be subdivided into different lots, varying in number and dimension according to the age and kind of the stock to be reared upon each. The nature of the land determines the age and kind of stock to be reared upon it; for it is found that some land will not suit breeding ewes, and others are unsuitable for hoggs. If the pasture consist chiefly of soft rough land, hoggs are best adapted for it; but if short and bare, ewes will thrive best upon it. That farm is best which contains both conditions of pasture, to maintain both breeding and rearing stock. In subdividing a farm into lots, each should, as much as possible, contain within itself the same quality of pasture, whether rough or short; for should fine and coarse grass be included within the same lot, the stock will remain almost constantly upon the fine, to the risk of even reducing their condition. To the extent of $\frac{1}{3}$ of coarse to fine may be permitted within the same lot, without apprehending much detriment to stock. Should a large space of inferior soil lie contiguous to what is much better, they should be divided by a fence; and, if requisite, a different breed of sheep reared upon each. By these arrangements, not only a greater number of sheep may be maintained upon a farm, but the larger number will always be in better condition.*

(1313.) The draining of pastoral farms is an operation of great importance, as a superior class of plants will thereby be encouraged to grow in places oc-

* A Lammermuir Farmer's Treatise on Sheep in High Districts, p. 51. The Lammermuir Farmer was the late Mr John Fairbairn, Hallyburton, a man of good sense and an excellent farmer, and whose acquaintance I was happy to cultivate.

cupied by coarse herbage, nourished by superabundant and stagnant water. A plan of laying out hill-drains may be seen in fig. 145. Their collected waters may be conveyed away to a contiguous rivulet or hollow in open main-drains, like that in fig. 146. A spouty swamp, of whatever extent, and wherever occurring, should be drained by coupled stone-drains, like fig. 159, cut to the bottom of under water; and the ordinary drains for conveying the water in the branches should be formed with a cover, like fig. 147. The arable portion of the farm should of course be drained by parallel drains, as represented in fig. 186, of the form of coupled drains, like fig. 159; and, if tiles are near as well as stones, like fig. 185. One means of keeping part of the surface dry, is to have the channel of every rivulet, however tiny, that runs through the farm, scoured every year in those parts where accumulated gravel causes the water, in rainy weather or at the breaking up of a storm, to overflow its banks; because the overflowed water, acting as a sort of irrigation, sets up a fresh vegetation, which is eagerly devoured by sheep in spring, to the risk of their health; and the sand carried by it, is left on the grass on the subsidence of the water, much to the injury of the teeth and stomachs of the sheep. The confinement of water within its channels also prevents it leaving the land, where inundated, unduly wet.

(1314.) In recommending a connection of arable with a pasture-farm, my object is simply to *ensure* an abundant supply of provision for sheep in winter. Were our winters so mild as to allow sheep to range over the hills in plenty and safety, no such connection need be formed—or, at least, to a greater extent than would supply provisions to its inhabitants, when situated far from a market. But when we are aware that severe storms at times almost overwhelm a whole flock, and protracted snows and frosts debar the use of the ground for weeks together, it is necessary that provision be made for the support of stock in those calamitous circumstances; and surely there is no better or more legitimate mode of supporting them, than of raising provision for them upon their own ground. I am quite aware of the folly of trusting to corn in a high district for rent, and am also aware that stock alone must provide that, and I have seen too many instances of failure in trusting to corn and neglecting stock; nevertheless, it cannot be denied, that the *more stock are provided with food and shelter in winter*, the less loss will be incurred during the most inclement season. Let one instance, out of many that could be adduced, suffice to shew the comparative immunity from loss enjoyed, by food and shelter being provided for sheep in winter. In the wet and cold winters of 1816 and 1818, the *extra*—that is, the more than usual—loss of sheep and lambs on the farm of Crosscleuch, Selkirkshire, was as follows:—

In 1816,	200 lambs, at 8s. each, . . .	L.80	0	0				
	40 old sheep, at 20s. each, . .	40	0	0				
					L.120	0	0	
In 1818,	200 lambs, at 8s. each, . . .	L.80	0	0				
	30 old sheep, at 20s. each, . .	30	0	0				
					L.110	0	0	
	Value of total *extra* loss, ...				L.230	0	0	

whereas, on the farm of Bowerhope, belonging to the same farmer, and on which ⅓ more sheep are kept, the *extra* loss in those years was as follows:—

In 1816,	70 lambs, at 8s. each, . . .	L.28	0	0	
	10 old sheep, at 20s. each, . .	10	0	0	
					L.38 0 0
In 1818,	50 lambs, at 8s. each, . . .	L.20	0	0	
	8 old sheep, at 20s. each, . .	8	0	0	
					28 0 0
	Value of total *extra* loss, ...				L.66 0 0
	Deduct loss on Crosscleuch, . . .				230 0 0
	Value saved on farm of Bowerhope, . .				L.164 0 0*

(1315.) Food and shelter being both necessary for the proper treatment of sheep in winter on pastoral farms, the means of supplying them demand the most serious attention of the store-farmer. During winter, sheep occupy the lower part of the farm. Hoggs are netted on turnips in the early part of the season, and ewes and other sheep subsist on the grass as long as it is green. The division allotted to green crop in the arable part of the farm contains 25 acres, and allowing 3 acres for potatoes for the use of the farmer and his people, there remain 22 acres for turnips; and as land among the hills is generally dry, turnips grow well upon it; so that 30 double-horse cart-loads to the acre, of 15 cwt. each, may be calculated on for a crop. It is judiciously recommended by Mr Fairbairn to carry off, about the end of October or beginning of November, if the weather is *open*—that is fresh—before the grass fails, $\frac{4}{5}$ of the turnips, and store them in heaps, as in fig. 213, and as described in (1235.); and allow the *ewe-hoggs*, retained to maintain the number of the ewe-flock after the draft-ewes have been disposed of, to eat the remaining $\frac{1}{5}$ off the ground, with whatever small turnips left when the others were pulled; and to strip the land in that proportion, 1 drill should be left and 4 carried off. This is, as I conceive, an excellent suggestion for adoption on every hill farm, especially as it secures the turnips from frost, and, at the same time, gives the entire command of them whenever they are required in a storm.

(1316.) It is found that *hoggs* fall off in condition on turnips in spring, in a high district, if confined exclusively upon turnip-land; not certainly for want of food, but probably from too much exposure to cold from want of shelter. They are, therefore, always removed from the turnips in the afternoon to their pasture, where they remain all night, and again brought back to the turnips in the following morning. It is obvious, that this necessary treatment, under the circumstances, deprives the land of much of the manure derivable from the turnips; and hence, farm-dung should be put on the land before the sowing of the following grain crop, where the previous turnips had been raised with bone-dust. The hoggs continue their daily visit to the land until all the turnips are consumed, which, amounting in all to $4\frac{1}{3}$ acres, may last, under the peculiar treatment, 17 score of hoggs—the number kept for refreshing the ewe-stock—about 6 or 7 weeks. After the land has been cleared of the turnips, the hoggs should be daily supplied from the store on their pasture, with 1 double cart-load to every 8 scores, which will be consumed in about 4 hours; and after that, they depend on the grass for the remainder of the day. Round turnips, having no

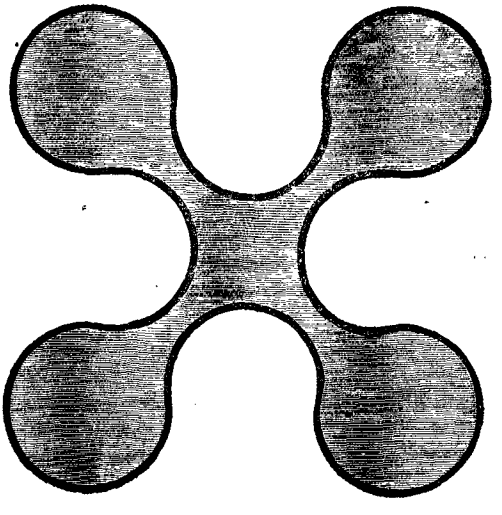
* Napier's Treatise on Practical Store-Farming, p. 126.

hold of the ground, give way to the upward bite of the sheep with the lower jaw teeth, and prove troublesome to them when laid down upon grass. When taken out of a store, they should therefore always be cut with a slicer. Hoggs are treated in this way until March, or longer if the weather is bleak; and the advantages of it are, that they are maintained in their condition, and become proof against the many diseases which poverty engenders; and their fleece weighs 1 lb. more at clipping-time. The cost of 8 acres of turnips given to hoggs, valued at L.3 an acre in a high district, is 17d. each, which is so far counterbalanced by the additional pound of wool which the cost ensures, and which is worth from 10d. to 1s. per lb. The balance of 5d. to 7d. a head, which is the true cost of the keep of the sheep, is a trifle compared to the advantage of bringing them through the winter in a healthy state and in fair condition.

(1317.) As to the older sheep, they must partly depend, in frost and snow, upon the 14 acres of turnips yet in store, and upon hay, and, of course, upon pasture in fresh weather. The hay is obtained from the 25 acres of new grass, which may be all made into hay; but allowing 5 acres for cutting-grass given in suppers to horses and cows, there remain 20 acres for hay, which, at 120 hay-stones (of 22 lb. to the stone) per acre, give 2400 hay-stones, or 3771 stones imperial. The 1000 ewes will eat 1½ lb. and the hoggs ½ lb. each every day, besides the two cart-loads of turnips amongst the lot. At this rate, the hay will last 31 days, which is a shorter time than many storms continue; but if the whole 25 acres of new grass were made into hay, it would last 40 days. But the rule should be to begin with a full hand of hay at the commencement of farming, and preserve what may be left over in a favourable season, and mix it with the new of the following season, for any subsequent unusual continuance of storm.

(1318.) But in a storm, their provender cannot be given to sheep upon snow,

Fig. 233.



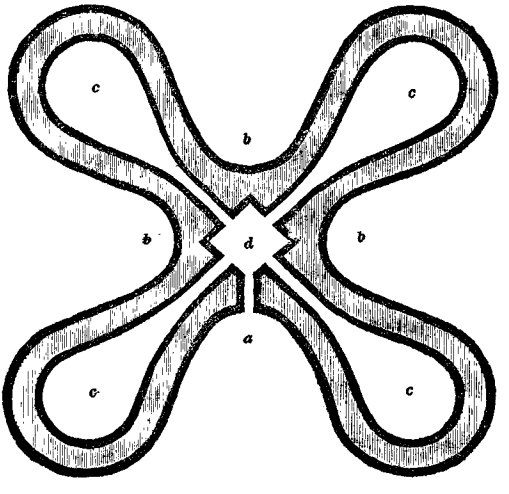
THE OUTSIDE STELL SHELTERED BY PLANTING.

safely and conveniently, as ground-drift may blow and cover both; and no place is so suitable for the purpose as a *stell*, a term, according to Dr Jamieson,

literally signifying a covert or shelter. There are still many store-farmers sceptical of the utility of stells, if we may judge of their opinions from their practice; but I presume no great sagacity is required to discover the fact, that stock seem much more comfortably lodged in a drifting storm within a high enclosure, than upon an open heath. A stell may be formed of planting or high stone-wall. Either will afford shelter; but the former most, though most costly, as it should be fenced by a stone-wall. Of this class, I conceive the form represented by fig. 233 a good one, and which may be characterized an *outside* stell. It has been erected by Dr Howison, of Crossburn House, Lanarkshire, and proved for 30 years. The circumscribing strong black line is a stone-wall 6 feet high, the dark ground within is covered with trees. Its 4 rounded projections shelter a corresponding number of recesses embraced between them, so that, let the wind blow from whatever quarter it may, two of the recesses will always be sheltered from the storm. The size of this stell is regulated by the number of the sheep kept; but this rule may be remembered in regard to its accommodation for stock, that each recess occupies about $\frac{1}{8}$ part of the space comprehended between the extremities of the 4 projections; so that, in a stell covering 4 acres—which is perhaps the *least* size they should be—every recess will contain $\frac{1}{2}$ an acre. "But, indeed," as Dr Howison observes, and which observation applies to the general benefit derived from every species of shelter, "were it not from motives of economy, I know no other circumstance that should set bounds to the size of the stells; as a small addition of walls adds so greatly to the number of the trees, that they become the more valuable as a plantation; and the droppings of the sheep or cattle increase the value of the pasture to a considerable distance around in a tenfold degree." *

(1319.) As a modified improvement of this form of stell, Dr Howison pro-

Fig. 234.



THE DOUBLE STELL SHELTERED BY PLANTING.

poses the one in fig. 234, which consists in giving shelter in its interior as well

* Prize Essays of the Highland and Agricultural Society, vol. xii. p. 334.

as on the outside, and may therefore be denominated a *double* stell. This form has never yet been tried; but if made on an adequate scale, I have no doubt of its efficiency. Instead of one opening into its interior at *a*, I think it should have one at the head of each recess at *b*, for the purpose of facilitating the shifting of the sheep from the outside into the interior chambers *c*, on a dangerous change of the wind. The hay-stack will be conveniently placed in the centre of the stell at *d*. This stell should scarcely occupy less ground than 7 acres to be really useful; thus, 1 acre in each of the projections, making 4 acres, divided into ½ an acre for each interior chamber *c*, and ½ an acre of wood around it; and each recess *b*, with the one at *a*, occupying ¾ of an acre, make other 3 acres, or 7 acres in all. But it would be better to occupy even more ground. The dark line circumscribing both the interior and exterior is a wall-fence, which would no doubt make this form of stell somewhat expensive, but it would have the great advantage of accommodating a large proportion of the flock for a long time at one place. Stells of this construction, besides affording shelter, would form embellishments to a pastoral country, and might moreover make a fence betwixt one farm and another. For instance, if it were desired to divide a 4-square-mile farm into one of 2 square miles, which had been fenced with a ring-fence planting, a few of these stells, placed in a row down the middle of the farm, with a single dyke from stell to stell, would not only divide the large farm into two small ones, but provide stells for both; and being double, half the number of ordinary ones would suffice.

(1320.) In making stells of planting, I think it would be desirable to have the outside row of such trees as do not project branches from their tops: branches, in such a place, only serve to drop water upon the sheep lying in the outside recesses or inside chambers; and the dropping is so far injurious to the sheep as to chill them with cold, or entangle their wool with icicles, before they get up at day-break to shake themselves free of the wet. This form of tree is found in the spruce, which affords, moreover, excellent shelter by its evergreen leaves and closeness of sprays, descending to the very ground. It should be empolyed to back the inside as well as the outside walls; and the space between them to be filled with Scots fir, larch, or such hardwood trees as will grow at the elevation. It must, however, be borne in mind, that as every soil does not suit spruce, it is impossible to follow this rule implicitly. Larch grows best amongst the debris of rocks and on the sides of ravines; Scots fir on thin dry soils, however near the rock they may be; and the spruce in deep moist soils.

(1321.) With regard to the number of stells or stone-fences on a farm, Lord Napier recommends the establishment of what he calls a "system of stells," which would place one in the "particular haunt" of every division of the flock. In this view, he considers that 24 stells would be required on a farm maintaining 1000 sheep; that is, 1 to little more than every 40 sheep.* However desirable it may be to afford full protection and shelter to stock, it is possible to overdo the thing—that is, incur more trouble and expense than necessary in accomplishing the object. On a farm where the practice is for the whole hirsel to graze together, it will almost be impracticable to divide them into lots of 40, one lot for each stell; and even if the division were accomplished, it would be with great waste of time, much bodily fatigue to the shepherd and his dog, and considerable heating to the sheep. I rather agree in opinion with Mr William

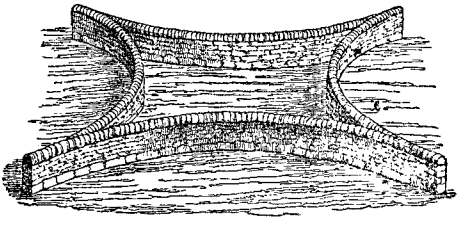
* Napier's Treatise on Practical Store-Farming, p. 122.

Hogg, shepherd at Stobohope, that stells should easily contain 200 sheep, or even 300 should be put into one on emergency; because, in the bustle necessarily occasioned by the dread of a coming storm, a large lot of 200 could easily be shed off from the rest, and accommodated in the recesses of a stell like fig. 233, which are accessible from all quarters; and 5 such stells would accommodate the whole hirsel of 1000 sheep.

(1322.) Suppose, then, that 5 such stells were erected at convenient places, not near any natural means of shelter, such as a crag, ravine, or deep hollow, but on an open rising plain, over which the drift sweeps unobstructed, and on which, of course, it remains in less quantity than on any other place. With a stack of hay inside and a store of turnips outside, every thing would be ready for the emergency. On a sudden blast coming, the whole hirsel might be safely lodged for the night in the leeward outside recesses of even one or two of the stells, and, should prognostics threaten a *lying storm;* next day, all the stells could be inhabited in a short time. Such a stell as fig. 234, filled outside and in, could hold the whole hirsel at one time. Lord Napier recommends a stack of hay to be placed close to the outside of every small circular stell; but these, I conceive, would be a great means of arresting the drift which would otherwise pass on.

(1323.) Mr Fairbairn recommends a form of stell something like fig. 233, without the planting, having 4 concave sides, and a wall running out from each

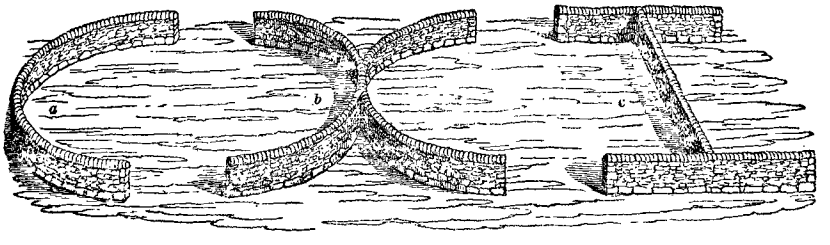
Fig. 235.



THE FORM OF STELL RECOMMENDED BY MR FAIRBAIRN.

salient angle, as in fig. 235; each stell to occupy ½ an acre of ground, to be fenced with a stonewall 6 feet high, if done by the landlord; but if by the ten-

Fig. 236.



THE ANCIENT STELLS.

ant, 3 feet of the wall to be built with stone, and coped other 3 feet with turf; which last construction, if done by contract, would not cost more than 2s. per

rood of 6 yards. An objection to this form of stell without a planting is, when the wind strikes into any of the recesses, it is arrested in its progress by coming against the perpendicular face of the wall, from which it strikes upwards, and then throws down the snow immediately beyond it; where, in this particular form, the drift would be deposited in the inside of the stell; and hence it is, I presume, that Mr Fairbairn objects to sheep being lodged in the inside of a stell.* This form, though affording more shelter, seems open to the same objections as may be urged against the forms of the ancient stells, *a*, *b*, or *c*, fig. 236, the remains of many of which may be observed amongst the hills, and might yet screen sheep from a boisterous blast in summer.

(1324.) There is much difference of opinion regarding the utility of *sheep-cots* on a store-farm. These are rudely formed houses in which sheep are put under cover in wet weather, especially at lambing time. Lord Napier recommends one to be erected beside every stell, to contain the hay in winter if necessary, and Mr Little even advises them to be built to contain the whole hirsel of sheep in wet weather. It seems a chimerical project to house a large flock of sheep for days, and perhaps weeks; and, if even practicable, it could not be done but at great cost. I agree with those who object to sheep-cots in high farms, because, when inhabited in winter, even for one night, by as many sheep as would fill them, an unnatural height of temperature is occasioned. Cots may be serviceable at night when a ewe becomes sick at lambing, or when a lamb has to be mothered upon a ewe who has lost her own lamb, because these cases being few at a time, the cot never becomes overheated.

(1325.) In an unsheltered store-farm it is found requisite to have 2 paddocks, and the number is sufficient to contain all the invalid sheep, tups, and twin lambs, until strong enough to join the hirsel. Hay should be stacked within, and the turnips stored around the outside walls, or in the planting of the stells. Tups may graze with the hirsel in the early part of the summer; but as no ordinary dyke will confine them in autumn, they should be penned in one of the stells, on hay or turnips, until put to the ewes.

(1326.) Where a rivulet passes through an important part of the farm, it will be advisable to throw *bridges* across it at convenient places for sheep to pass along without danger, either to better pasture or better shelter on the opposite bank. Bridges are best constructed of stone, and though rough, if put together on correct principles, will be strong, but if stones cannot be found fit for arches, they may do for buttresses, and across these trees may be laid close and held together by transverse pieces 6 feet long, which, when covered with tough turf, will form a broad and safe roadway.

(1327.) These are all the remarks that occur to me in reference to the management of a low pastoral farm in winter; and although many of them are equally applicable to a *high store-farm*, yet their circumstances are so far different as to warrant modifications of management. There is one circumstance which obviously renders modifications in management necessary, and that is the difference in habit betwixt the *Black-faced* and Cheviot breeds of sheep, the former being the best suited for a high farm. Some of the hill-farms extend to the highest points of our mountain ranges, to 4000 feet above the level of the sea, and embracing many thousand acres; and as land at that elevation cannot be expected to yield much nutritious vegetation, many acres in some places are

* A Lammermuir Farmer's Treatise on Sheep in High Districts, p. 58.

required to support a single sheep, so that a farm containing 1000 sheep may require from 20,000 to 5000 acres; but there are few hill-farmers who possess only 1000 sheep. The circumstance of elevation and seclusion from roads also impose modifications in the feeding from that pursued in the lower country. The store-farmers of the lower country sell what lambs they can spare after retaining as many as will keep their ewe-stock fresh. They thus dispose of all their wether-hoggs, the smaller ewe-hoggs, and draft-ewes, which, if parted with at an early age, say 3 years, become more easily fattened on turnips in the low country than wethers of the same age. Suppose that 1000 ewes wean 1000 lambs, 500 of these will be wether and 500 ewe hoggs, of which latter 17 score, or 340, will be retained, and the remaining 160 disposed of. It is the practice of the hill store-farmer, on the other hand, to purchase these lambs, rear them until fit, as wethers, to go to the low country to be fed fat on turnips, and being a purchaser of lambs keeps fewer breeding ewes than wethers.

(1328.) It seems impracticable to have arable land on a hill-farm, at least hill-farmers are unwilling to admit that turnips are the best food for their stock in winter. Whatever may prompt them to object to any arable culture on their farms, it would require very cogent reasons to prove that Black-faced sheep would not thrive well on turnips in the hills, if these could be raised in sufficient quantity upon the spot. Doubtless on many farms, far removed from the great thoroughfares of the country, it would be very difficult to bring even a favourable spot into culture, and especially to raise green crops upon them as they should be; but, on the other hand, there are many glens among the hills, not far removed from tolerable roads, in which culture might be practised to great advantage, the produce of which would assist to maintain the condition of the flock through a stormy period of 6 weeks or 2 months.

(1329.) As a corroborative proof of the utility of some culture on hill-farms, it is the practice of many hill-farmers to take either turnips or a rough grazing for their stock in the lower part of the country, as nearly adjacent to their homes as food can be procured; and many lowland-farmers, who possess hill-farms besides, bring down their young sheep to the low country in winter, and put them on turnips. When turnips, however, are taken for this purpose, a considerable expense is incurred, and a rough pasture, though less efficacious than turnips, may bring the stock through the dreary part of winter tolerably well; but the conveniences of home are awanting here, and when snow falls deep, and covers the ground for weeks together, little provision has been made to get at the turnips in the fields; and then whins and bushes afford the only food where there is no hay; but where there is it is of course given them, but then, in this case, there was no use of incurring the expense and enduring the fatigue of the flock going from home, when hay could be given them in their own haunts. Hence the necessity, wherever turnips are, of storing a large proportion to be used in emergencies. Where a Scots-fir plantation is near a haunt of sheep they need not starve, for a daily supply of branches, fresh cut from the trees, will not only support them but make them thrive as heartily as upon hay alone; and if a small quantity of hay is given along with the fir-leaves, they will thrive better than on hay alone.*

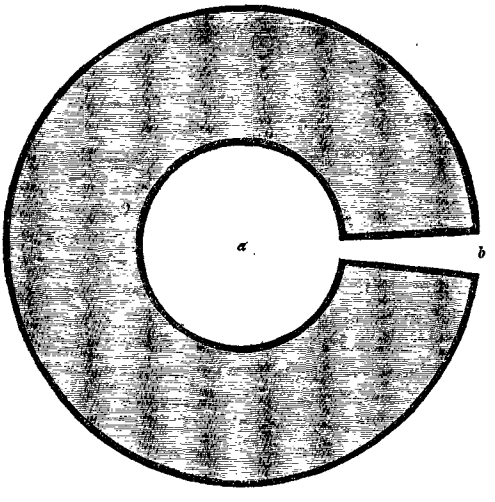
(1330.) One inducement may make some hill-farmers send their stock to a lower country in winter, namely, the want of adequate shelter at home. Their

* Little's Practical Observations on Mountain-Sheep, p. 44.

hills are bare of wood, the few trees being confined to the glens; and of course sheep can find no shelter in their usual grounds; and it is surprising how susceptible of cold even Black-faced sheep are when the atmosphere is becoming moist. They will cover down, creep into corners and beside the smallest bushes for shelter, or stand hanging their heads and grinding their teeth, having no appetite for food. If a piercing blast of wind follows such a cold day, the chances are that not a few of them perish in the night, and if thick snow-drift comes on, they drive before it, apparently regardless of consequences, and get into some hollow, where they are overwhelmed. Thus the utility of stells become apparent, and many hearty wishes are no doubt expressed for them by the farmer and his shepherd, when too late to save the flock.

(1331.) Much diversity of opinion exists in regard to the best form of stell for high pastures, where wood seldom grows. At such a height the spruce will not thrive; and the larch being a deciduous tree, affords but little shelter with its spear-pointed top. There is no tree but the evergreen Scots fir fit for the purpose, and, when surrounding a circular stell, such as is represented by fig. 237, it affords very acceptable shelter to a large number of sheep. In reference to

Fig. 237.



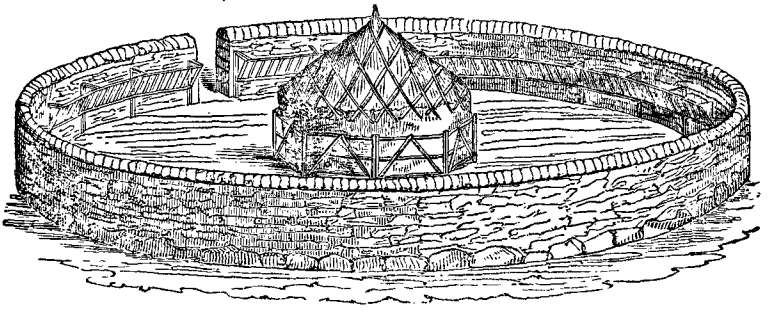
THE INSIDE CIRCULAR STELL SURROUNDED WITH PLANTING.

this particular form of stell, it consists of 2 concentric circles of wall, represented by the dark lines in the figure, enclosing a planting of Scots fir, and having a circular space *a* in the centre for sheep, which can be made as large as to contain any number. This may be denominated an *inside* stell, in contradistinction to that in fig. 233, and has been proved efficient by the experience of Dr Howison. Its entrance, however, is erroneously made wider at the mouth than next the interior circle *a*, which has the effect of increasing the velocity of the wind into the circle, or of squeezing the sheep when they enter the passage in numbers. Were the passage parallel it would be better, but if wider at the inner end it would be of still better construction.

(1332.) But where trees cannot be planted with any prospect of success,

stells may be formed without them, and indeed usually are, and of all the forms that have been tried the *circular* has obtained the preference on hill-farms; but the difficulty of determining their size as the best, is still a matter of dispute amongst hill-farmers. Lord Napier thinks that 7 yards diameter is a good size, and that the largest should not exceed 10 yards inside measure; while Mr William Hogg approves of 18 yards. I am inclined to agree with Mr Hogg. In the first place, the circular form is better than a square, a parallelogram, or a cross; because the wind striking against a curved surface, on coming from any quarter, is divided into two columns, each weaker than the undivided mass; whereas, on striking against a straight surface, though its velocity is somewhat checked, it is still undivided, and its force still great, when it rebounds upwards with increased force, and curling over the top of the wall throws down the snow a few yards only beyond it, that is, into the interior of the figure. Any one who has noticed the position of drifts of snow on each side of a straight stone-dyke, will remember that the leeward-side of the dyke is completely filled up, and that on the windward a hollow is left often clear to the ground between the snow and the dyke. Every form of stell, therefore, that presents a straight face to the drift will be filled up behind the front wall, and can be no protection to sheep against being blown over with snow. Of two curves, that which has the larger diameter will, it is obvious, divide the drift the farther asunder. A stell of small diameter, such as 7 yards, dividing a mass of drift, the current of air immediately over the stell is suddenly cut in two, but to so small a height, that the snow from the air above falls between them into the stell. When, on the other hand, a stell of large diameter, as of 18 yards, divides a column of air, this is so much deflected on each side that the current above the stell is widely divided to a considerable height, and, long before it regains its former state, it has passed over the stell, where it deposites its snow; and hence near such a stell the snow is found to accumulate in a triangular shape, with its apex away from the stell quite to leeward of the most distant part of the wall; and of course leaves the interior free of snow. Fig. 238 represents one of 18 yards diameter inside, surrounded by a wall of 6 feet high, the first 3 feet of which

Fig. 238.



THE CIRCULAR STELL FITTED UP WITH HAY-RACKS.

may be of stone, and the other 3 feet of turf, and will cost 2s. 4d. per rood of 6 yards, if erected by the tenant, but if by the landlord, and wholly of stone and coped, will cost 7s. per rood: this size gives 9⅓ roods, which at 7s. makes

its cost L.3 : 5 : 4, including the quarrying and carriage of the stones, a trifling outlay compared to the permanent advantage derived from it on a hill-farm. The opening into the stell should be from the side towards the rising ground; and its width 3 feet, and of the whole height of the wall, as seen in the figure; or it is sometimes a square of 3 or 4 feet, on a level with the ground, in which case the stell is entered by stile-steps over the wall. Such a structure should supersede the use of every antiquated form that has been tried, such as the single crescent *a*, fig. 236, double crescent *b*, or double T *c*; and it will easily contain 10 score of sheep for weeks, and even 15 or 16 score may be put into it for a night without being too much crowded together.

(1333.) Stells should be fitted up with *hay-racks* all round the inside, as in fig. 238, not in the expensive form of the circle, but of a many-sided regular polygon. It is a bad plan to make sheep eat hay by rotation, as recommended by Lord Napier and Mr Little, but condemned by Mr Fairbairn, for the timid and weak will be kept constantly back, and suffer much privation for days at a time. Let all have room and liberty to eat at one time, and as often as they choose. The hay-stack should be built in the centre of the stell, as in fig. 238, where it should be placed on a basement of stone, raised 6 inches above the ground. A small stack, 5 yards in diameter at the base, 6 feet high in the stem, with a top of 6 feet in height, will contain about 450 hay-stones of hay, which will last 200 sheep 33 days, about the average duration of a long storm; but upon the same base a much greater quantity of hay could be built. The interior circumference of the stell measures 160 feet round the hay-racks, and if 8 or 9 six-feet flakes were put round the stack, at once to protect the hay and serve as additional hay-racks, that would give 47 feet more, which together afford 1 foot of standing room to each of 200 sheep at one time, and supersede the objectionable plan of feeding them in rotation.

(1334.) Stells form an excellent and indispensable shelter for sheep in a snow-storm, when deprived of their pasture; but it has occurred to me that, in want of stone-stells, very good stells or chambers might be made of snow of any form or size desired. Even around the space occupied by sheep, after a heavy fall of snow, a stell might be constructed of the snow itself, taken from its interior and piled into walls as wide and high as required. Such a construction would remain as long as the storm endured, a new storm could be made available for repairs, and even after the ground was again clear, the snow walls would remain as screens for some time after. A small drain or two, in case of a thaw, would convey away the water as the snow melted. As long as the ground continues green, natural shelter is as requisite as stells,—these consist of rocks, crags, braes, bushes, heather, and such like. To render these as available to sheep as practicable, the ground should be cleared of all obstructions around them, and bushes planted in places most suited to their growth, such as the whin (*Ulex europæus*), in poor thin clay, and it is a favourite food of sheep in winter; the broom (*Genista scoparia*), on rich light soil; the juniper (*Juniperus communis*), in sandy soil; the common elder (*Sambucus nigra*), in any soil, and it grows well in exposed windy situations; the mountain ash (*Pyrus aucuparia*), a hardy grower in any soil; and the birch when bushy (*Betula alba*), grows in any soil, and forms excellent clumps or hedges for shelter, as well as the hazel (*Corylus avellana*), and the common heaths (*Erica vulgaris* and *tetralix*), when they get leave to grow in patches to their natural height in peaty earth.

(1335.) Since *hay* is the principal food given to sheep in snow or in black frost, it is matter of importance to procure them this valuable provender in the best state, and of the best description. It has long been known that irrigation promotes, in an extraordinary degree, the growth of the natural grasses; and perhaps there are few localities which possess greater facilities for irrigation, though on a limited scale, than the Highland glens of Scotland. Rivulets meander there through haughs of richest alluvium, which bear the finest description of natural pasture plants, and yet irrigation is entirely neglected in those regions. Were the rivulets in winter subdivided into irrigating rills, the produce of these haughs might be multiplied many fold. It is not my purpose *here* to describe the management of irrigating meadows,—that I will do ere all the winter operations terminate; nor is it my intention to describe the best mode of converting natural grass into hay, for that will form part of our occupation in the summer season: all that is requisite to be said in this place on the subject of irrigated meadows is, that, as they might be formed with great advantage to stock in many places where they are at present neglected, I cannot too earnestly draw the attention of hill-farmers to their utility; and although the localities in which they can be constructed are limited in extent, they will not be the less valuable on that account. One obstruction to their formation is the necessary fencing required around them, to prevent the trespass of stock while the grass is growing for hay. Besides places for irrigation, there are rough patches of pasture frequently found in the hills, probably stimulated to growth by latent water performing a sort of under-irrigation to the roots of the plants, which should be mown for hay; and to save farther trouble, *this* hay should be ricked on the spot, and surrounded by small hurdles, through which the sheep could feed in frosty weather from the rick, and keep themselves in fair condition. They would assemble round the stacks at stated hours, and, after filling themselves with dry food, again wander over, it may be, the bare but green sward for the remainder of the day, until severe black frost make them frequent the stacks; and when snow comes, the stells would be their place of refuge and support. As the hay in the stacks is eaten in, the flakes should be drawn closer around them, to allow it to approach again within reach of the sheep.

(1336.) [*Sheep-flakes or hurdles.*—Flakes are constructed in two different forms. The one represented by fig. 216 is the strongest and most durable, but is also the most expensive in first cost. The figure exhibits 2 flakes joined and supported, in the way they are placed, to form a fence. Each flake of this construction, with its fixtures, consists of 14 pieces, viz. 2 side-posts *a*, 4 rails *b*, and 3 braces, *c d d*, which go to form the single flake; and 1 stay *f*, 1 stake *g* or *e*, and 3 pegs *h* or *i*, which are required for the fixing up of each flake. The scantling of the parts are the side-posts 4½ feet long, 4 inches by 2 inches. The rails 9 feet long, 3½ inches broad by 1 inch thick. The braces, 2 diagonals 5 feet 2 inches long, 2¼ inches broad by ¾ inch thick, and 1 upright 4 feet long, and of like breadth and thickness. The stay is 4½ feet long, 4 inches broad, and 2 inches thick, and bored at both ends for the pegs; the stake 1½ foot long, pointed and bored. The pegs 1 foot long, 1¼ inch diameter.

(1337.) The preparation of the parts consists in mortising the side-posts, the mortises being usually left round in the ends, and they are bored at equal distances from the joining and stay pegs. The ends of the rails are roughly rounded on the edges, which completes the preparation of the parts; and

when the flake is completed, its dimensions are 9 feet in length, and 3 feet 4 inches in breadth over the rails; the bottom rail being 9 inches from the foot of the post, and the upper rail 5 inches from the head.

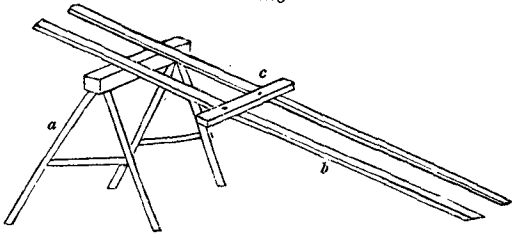
(1338.) The other form of flake, which is by far more extensively employed, though by no means the best, consists of the same parts, except that it has always five rails, and the only material difference in the scantling is, that the rails are all $1\frac{3}{4}$ inch square. An essential difference also occurs in the preparation or manufacture of this kind of flake. The ends of the rails are all turned round by machinery, and the side-posts are bored for their reception, as well as for the pegs by like machinery. The five rails in the flake are divided in height as follows: The bottom rail 9 inches from the foot of the posts; the spaces *between* the first and second, and the second and third rails, are each 7 inches, and the two upper spaces are respectively 8 and 9 inches, leaving, as before, 5 inches of the post above the upper rail.

(1339.) Flakes of this last description are extensively manufactured in Perthshire, where young larches are abundant, for of that wood they are generally made. Their price, when sold in retail by fifties or hundreds, is 1s. 9d. to 2s. each flake, including all the parts, sold in pieces; the expense of putting the parts together is usually 2d. each flake, including nails. The bar-flake first described is not generally to be found in the market, and is chiefly made to order; the price about 2s. 6d. each flake, with fixtures.—J. S.]

(1340.) As hurdles in England are somewhat differently put together, as well as made of a different sort of wood; and as the folding of sheep on turnips is differently managed in that country from what is given above, it seems proper to advert for a little to both these subjects; and first as to the structure of hurdles.

(1341.) Where the common crack-willow (*Salix fragilis*) will grow, every farmer may have poles enough every year for making 2 or 3 dozen hurdles to keep up his stock. To establish a plantation, large cuttings 9 or 10 feet long should be pushed, not driven, into moist soil, and on being fenced from cattle, will soon shoot both in the roots and head, the latter being fit to be cut every seventh year. Where soil for a willow-plantation does not naturally exist, the farmer can buy his hurdles ready made at 16s. the dozen; when made at home they cost 4d. each, and when the shepherd makes them they cost only his time. Hurdle-makers go the round of the country, and make at 4d. and mend at 2d. each, finding their own tools.

Fig. 239.

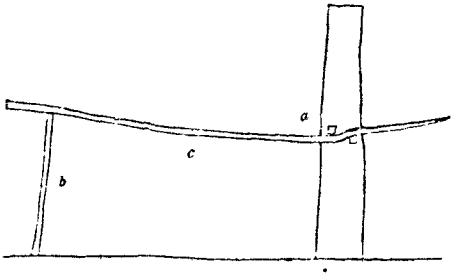


THE BENDING-FRAME IN HURDLE-MAKING.

(1342.) " A hurdle-maker's tools," says Mr Main, " are a hand-saw,

light hatchet, draw-shave, flamard, a centre-bit and stock, a tomahawk, and gimlet. He has also a rending-frame, which is a common tressel *a*, fig. 239, on which 2 strong poles *b* are laid, leaning and connected by a piece *c* called a bridge. Besides this, he has a contrivance for shaving the poles, &c. In doing this, 2 auger-holes are bored in a post, to admit 2 stout square iron stubs, having ears to assist withdrawing them when done with. The stubs project from the surface of the post about 6 inches, let in about 3 feet from the ground, and 8 inches from each other, though not exactly horizontally, the one nearest the workman being higher than the other, as seen at *a*, fig. 240. The

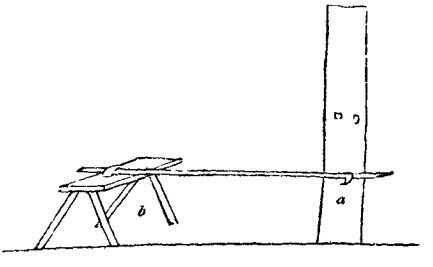
Fig. 240.



THE POSITION OF THE STUBS AND STANDARD IN HURDLE-MAKING.

use of these stubs is to hold the poles while they are shaved; being at the same time supported by a standard *b* about 3 feet from the post, and having a sharp short spike on the top to steady the pole *c* under the action of the draw-shave.

Fig. 241.



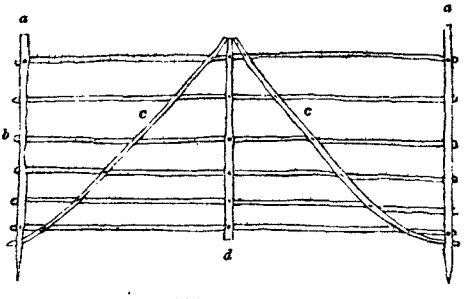
THE SQUARE STAPLE AND STOOL IN HURDLE-MAKING.

In the same post a square staple *a*, fig. 241, is driven, to hold the feet of the heads while they are mortised, assisted by a low stool *b*.

(1343.) "All these things being ready, the poles are prepared for the different purposes to which they can be converted. The butt-end of the pole is first sawed off; 4½ feet lengths make a pair of heads *a*, fig. 242; 9 feet lengths

make a pair of slots *b*; 5 feet lengths make a pair of stay-slots *c*; and 3½ feet lengths make a pair of uprights *d*.

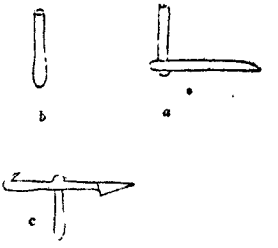
Fig. 242.



THE HURDLE.

(1344.) "The next proceeding is rending the different pieces, which is done at the rending-frame, fig. 239. The piece is put over the bridge *c*, with the butt-end upwards. The flamard *a*, fig. 243, an edge-tool of iron, with a wooden handle, is placed across the pith, and driven down with a wooden baton *b*. When entered down 1 or 2 feet, the pole is brought up to bear upon the bridge, and at the same time on the under side of the top of the tressel. The pole being kept down by the left hand, while the flamard is guided by the right, by bending and turning the pole, the cleavage is performed from end to end with great exactness. They next undergo a little chopping or hewing with the hatchet, to cut off the knobs on the outside, keeping the inside as square as possible. The next operation is shaving off the bark and all irregularities, and giving each member of the hurdle its proper form.

Fig. 243.



THE FLAMARD, BATON, AND TOMAHAWK, IN HURDLE-MAKING.

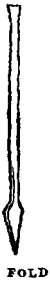
(1345.) "The maker next proceeds to form the hurdle; 4 low stumps are driven into the ground to mark the length, and 4 other to mark the distance between the upper and lower slots; a pair of heads, one at each end, are laid down in their right position, the flat or pith side upwards; the 6 slots are then laid at due distances upon the heads, and the latter are *scribed* to the size of each slot, to regulate the mortises. The hurdle-maker uses no foot-rule in his operations, he having rods cut to the different lengths of the respective pieces; and the entire distances between the slots are arranged by the eye, the lower ones being gradually closer together, as seen in fig. 242; and the strongest pair of slots are usually chosen for the highest and lowest of the hurdle. One of the heads is then placed on the staple *a*, fig. 241, and resting on the top of the mortising stool *b*, to which it is fixed in an opening by a wedge. The centre-bit and stock drills out a hole at each end of the mortises, and also one for the diagonal-brace slot, about 2 inches below the lowest slot, and a little out of the line of the mortises above. It will be observed that mortises made by a centre-bit leaves an intermediate piece between the apertures, which is taken out by the

tomahawk *c*, fig. 243, a tool made for the purpose. One end is a sharp stout pointed knife, which cuts each side of the middle piece left in the mortise, and the other end hooks out the piece not dislodged by the knife. The mortising, which, with a mallet and chisel would take up 1 hour, is done with the centre-bit and hawk in 5 minutes. This head is now hammered on to the slots, and the other head is prepared and hammered on in the same way. The top and bottom slots are next nailed to the heads, and then the upright slot exactly in the middle. The 2 stay-slots are cut with a bend at the bottom, and rather sharply pointed; the points are driven through these oblique mortises, and their heads brought up to bear on the top of the upright, and nailed to each slot from top to bottom. The hurdle is then raised on its feet, and the nails clenched, which finishes the business. The gimlet is used for every nail, and a small block of wood placed under each slot while the nail is driven. The nails used are of the best iron, and what are called *fine-drawn*, not square, but rather flattened, to facilitate clenching, on which much of the strength of the hurdle depends; the head of the nail is somewhat large, their price is 6d. per lb.; 100 poles at 18s. make 36 hurdles, which, including nails and workmanship, cost L.1 : 11 : 6, or 10s. 6d. per dozen. Although the horizontal slots are cut 9 feet long, the hurdle, when finished, is only somewhat more than 8 feet, the slot ends going through the heads 1 or 2 inches: 2 hurdles to 1 rod of 16 feet, or 8 to 1 chain of 22 yards, are the usual allowance."

(1346.) A larger kind of hurdle, called *park hurdles*, worth 2s. each, is made for subdividing meadows or pastures, and are a sufficient fence for cattle. From all this it is obvious, that when the small hurdles are used for sheep, the larger class must be obtained to fence cattle, whereas the Scotch flake described above, (1336) and in fig. 216, answer both purposes at once, and are therefore more economical.

(1347.) "The hurdles being carted to the field," continues Mr Main, "are laid down flat, end to end, with their heads next to, but clear of, the line in which they are to be set. A right-handed man generally works with the row of hurdles on his left. Having made a hole in the hedge, or close to the dyke, for the foot of the first hurdle, with the *fold-pitcher*, fig. 244, which is a large iron dibber, 4 feet long, having a well-pointed flattened bit, in shape similar to the feet of the hurdles, he marks on the ground the place where the other foot is to be inserted; and there with his dibber he makes the second hole, which, like all the others, is made 9 inches deep. With the left hand the hurdle is put into its place, and held upright while lightly pressed down by the left foot on the lowest slot. This being done, the third hole is made opposite to, and about 6 inches from, the last. The dibber is then put out of hand, by being stuck in the ground near where the next hole is to be made; the second hurdle is next placed in position, one foot on the open hole, and the other foot marks the place for the next hole, and so on throughout the whole row. When the place of the second foot of a hurdle is marked on the ground, the hurdle itself is moved out of the way by the left hand, while the hole is made by both hands. When the whole row is set, it is usual to go back over it, giving each head a slight rap with the dibber, to regulate their height, and give them a firmer hold of the ground. To secure the hurdles steady against the rubbing of the sheep, couplings, or, as they are commonly called, *copses*, are put over the heads of

Fig. 244.



THE FOLD-PITCHER IN HURDLE-SETTING.

each pair where they meet, which is a sufficient security. These couplings are made of the twigs of willow, holly, beech, or any other tough shoots of trees, wound in a wreath of about 5 inches diameter.

(1348.) "The number of hurdles required for feeding sheep on turnips is one row the whole length of the ridges of an enclosed field, and as many more as will reach twice across 2 eight-step lands or ridges, or 4 four-step lands, that is, 48 feet, or 3 or 4 ridges of 15 feet. This number, whatever it may be, is sufficient for a whole quadrangular field, whatever number of acres it may contain. The daily portions are given more or less in length, according to the number of the flock. Two of these portions are first set, the sheep being let in on the first or corner piece. Next day they are turned into the second piece, and the cross-hurdles that enclosed them in the first are carried forwards, and set to form the third piece. These removes are continued daily till the bottom of the field is reached; both the cross-rows are then to spare, and are carried and set to begin a new long-row, close to the offside of a furrow, and the daily folding carried back over 2 or 4 lands as at first. It is always proper to begin at the top of a field, if there be any difference of the level, in order that the flock may have the driest lair to retire to in wet weather.

(1349.) "When there is a mixed flock, that is, couples, fattening and store sheep, two folds or pens are always being fed off at the same time, which only require an extra cross-row of hurdles. The couples have the fresh pens, while the lambs are allowed to roam over the unfolded turnips, by placing the feet of the hurdles, here and there, far enough apart, or by lamb-hurdles made with open pannels for the purpose. The fattening sheep follow the couples, and have the bulbs picked up for them by a boy. The stores follow behind and eat up the shells."* It is never the practice in Scotland to put ewes with their lambs upon turnips, as new grass is considered much better for them, but the only ewe and lamb that can be seen on turnips in winter are of the peculiar breed of Dorsetshire. The *store*-sheep in Scotland—that is, the ewe-hoggs—are always fed as fully as the wether-hoggs which are intended to be fattened. In England the entire turnip-stock, ewes, lambs, and wethers, are all intended for the butcher; and even, if possible, sold before the turnips are ended. The whole have hay or trough-meat either in the field or in the sheep-house, on wet or stormy nights. An acre of good turnips maintains 5 score of sheep for 1 week.

(1350.) *Nets*, by which sheep are confined on turnips in winter, are made of good hempen twine, and the finer the quality of the material, and superior the workmanship bestowed on the manufacture of the twine, the longer will nets last. Being, however, necessarily much exposed to the weather, they soon decay, and, if guided carelessly, can scarcely be trusted more than a season. No treatment destroys them so rapidly as laying them by for the season in a damp state; and if rolled up wet even for a few days, they become mildewed, after being affected with which, nothing can prevent them rotting. They should never be laid by either damp or dirty, but washed and thoroughly dried in the open air before being rolled up and stowed away. It is alleged by shepherds, that nets decay faster in drought and exposure to dews and light in summer, than in winter. Several expedients have been tried to preserve nets from decay, among others, tanning, in imitation of fishermen; but however well that process may suit nets used in the sea, it makes them too hard for the shepherd's use in tying the

* Quarterly Journal of Agriculture, vol. iii. p. 647–53.

knots around the stakes. Perhaps a steeping in Kyan's solution might render them durable, and preserve their pliability, at the same time. The company's charge is 5s. per cwt. for nets and cordage. It should be kept in mind that nets made of twine bleached by acids or other chemical process should not be submitted to Kyan's solution.

(1351.) *Sheep-nets* are wrought by hand, at least I have never heard of machinery being yet applied to their manufacture. They are simply made of *dead netting*, as it is technically called, which consists of plain work in regular rows, and is wrought by women as well as men. A shepherd ought to know how to make nets as well as mend them, which he will not do well unless he understand, in the first place, how to make them.

(1352.) All the instruments required in this sort of net-making are a *needle* and *spool*. "Needles are of two kinds, those made alike at each end with open forks, and those made with an eye and tongue at one end and a fork at the other. In both needles the twine is wound on them nearly in the same manner, namely, by passing it alternately between the fork at each end, in the first case, or between the fork at the lower end and round the tongue at the upper end, in the second case; so that the turns of the string may lie parallel to the length of the needle, and be kept on by the tongue and fork. The tongue and eye needle is preferable both for making and mending nets, inasmuch as it is not so liable to be hitched into the adjoining meshes in working; but some netters prefer the other kind, as being capable of holding more twine in proportion to their size." An 8-inch needle does for making nets, but a 4-inch one is more convenient for mending them. *Spools*, being made as broad as the length of the side of the mesh, are of different breadths. They "consist of a flat piece of wood of any given width, of *stout* wood, so as not to warp, with a portion cut away at one end, to admit the finger and thumb of the left hand to grasp it conveniently. The twine in netting embraces the spool across the width; and each time that a loop is pulled *taught*, half a mesh is completed. Large meshes may be made on small spools, by giving the twine two or more turns round them, as occasion may require." "In charging your needle, take the twine from the *inside* of the ball. This prevents tangling, which is at once recommendation enough. When you charge the needle with *double* twine, draw from 2 separate balls."* It is almost impossible to describe the art of netting by words, so as to render it intelligible, and I shall not therefore attempt it; but it may be learned from any shepherd. In joining the ends of *twine* together, which, in mending, is necessary to be done, the *bend* or *weaver's* knot is used, and in joining top and bottom ropes together in setting nets, the *reef*-knot is best, as the tighter it is drawn the firmer it holds.

(1353.) Sheep-nets run about 50 yards in length when set, and weigh about 14 lb. Hogg-nets stand 3½ feet in height, and dinmonts 3 feet 3 inches, and both are set 3 inches above the ground. Stakes, to have a hold of 9 inches of the ground, bear the net 3 inches from the ground, and be 3 inches above the net-cord, should be 4½ feet in length for the dinmont, and 4 feet 9 inches for the hogg net. The mesh of the hogg-net is 3½ inches in the side, and of the dinmont 4¼ inches; the former requires 9½ meshes in the height, the latter 8½. The twine for the hogg-net is rather smaller than that for the dinmont, but the *top* and *bottom rope* of both are alike strong. A hogg-net costs 12s.,

* Bathurst's Notes on Nets, pp. 15. 17, and 138.

or under 3d. per yard; a dinmont 10s., or under 2½d. per yard, on the Border, as at Berwick-upon-Tweed and Coldstream; but they are now sold in the prison of Edinburgh, being the work of the prisoners, at 7s. 6d., or under 2d. per yard; while in London the charge is 4½d. per yard.

(1354.) It is generally imagined that nets are not suitable for confining Black-faced sheep on turnips, chiefly because they are liable to be entangled in them by their horns; but this objection against the use of nets, is not insuperable, as the following circumstance will shew. A farmer, a very extensive feeder of Black-faced sheep, on seeing my Leicester hoggs on turnips confined by nets, expressed a willingness to try the same method of confining his own sheep, adducing the great expense of hurdles as a reason for desiring a change. After getting a pattern net from me to stand 4 feet high, he got others made like it; and so successful was his experiment the first season, that he ever after enclosed a large proportion of his Black-faced sheep by nets. There occurred a few cases of entanglement for some days at first, but as his shepherd was constantly employed among his large flock, and having none else to attend to, no harm arose either to sheep or net, and in a short time the sheep became aware of the trap and avoided it. They never attempted to overleap the nets, though they would never have hesitated to do so over a much higher wall.

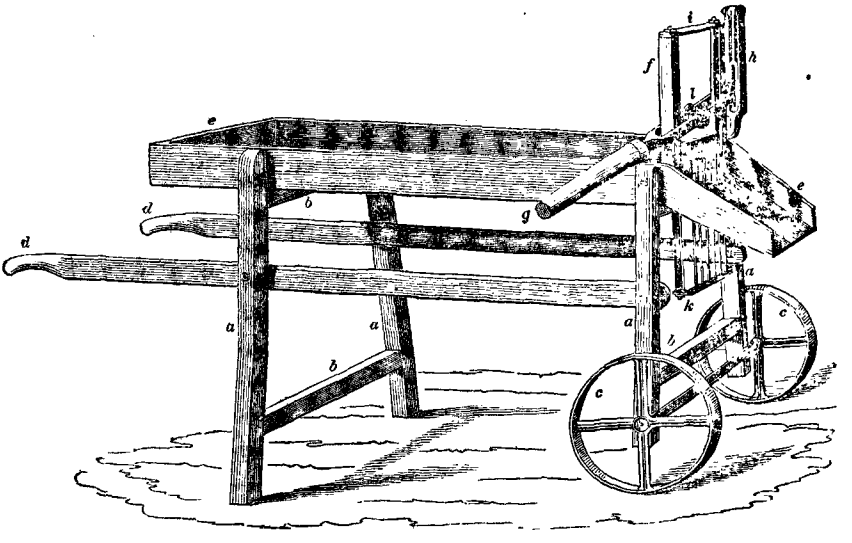
(1355.) [*Turnip-Slicers for Sheep.*—Machines for slicing roots, and particularly for the turnip, are constructed in a great variety of forms, but may be classed under two leading groups,—those that cut the turnip simply into circular discs, as generally adopted for the feeding of cattle, and those that cut at one operation into oblong rectangular pieces or parallelopipedons, commonly practised for feeding sheep; forming a somewhat more complicated class of machine. This last class, as coming first in the order of application, I shall first describe. Turnip-slicers for sheep may be again subdivided into lever and revolving machines; and of the many varieties under these forms, there are the stationary, the portable, the wheel-barrow, and what may be called the locomotive machine. This last being rendered so by its attachment to a cart, and by its own motion thus communicated, performs the operation of slicing while it travels over the field.

(1356.) The first introduction of the turnip-slicer is, like many other equally useful inventions, lost in obscurity, but it is most probable that, like the cultivation of the root itself, it originated in England; and it is likewise probable that the first attempt was the simple *chopper* still used to chop turnip for cattle. It appears uncertain whether the lever or the revolving slicer came first into use, as does also the time of their introduction. But we have an authentic record of a premium having been offered in 1806 by the Board of Trustees for the Encouragement of Arts and Manufactures in Scotland, for a revolving turnip-slicer. This was awarded to John Blaikie, carpenter to the late Lord Polwarth, then Mr Scott of Harden, which is believed to have been the earliest application of that form of the machine in Scotland.

(1357.) *Lever Turnip-Slicer for Sheep.*—The first of the sheep turnip-cutters that I shall notice, is one of the lever form, but in its mechanical construction may be very aptly called the gridiron turnip-cutter, and is represented in an entire form in fig. 245, which is a perspective view of the machine. It consists of a wooden frame supporting a trough, together with the cutting apparatus. The frame is formed of the four posts *a*, *a*, *a*, *a*, which are 2¼ inches square. The front pair stand 15 inches in width, over all at top, the hind pair 19 inches; in both they spread a little below, and are separated to a distance of about 34 inches.

Each pair is connected by cross-rails *b*, *b*, and they are connected longitudinally by the bars *d*, *d*, 4½ feet long, which form also the handles of the wheel-barrow; being bolted to the posts at a suitable height for that purpose; their scantling is 2 by 1½ inches. A pair of wheels, *c c*, of cast-iron, 9 to 12 inches diameter, fit-

Fig. 245.



THE LEVER TURNIP-SLICER FOR SHEEP.

ted to an iron-axle, which is bolted to the front posts, gives it the conveniency of a wheel-barrow. The trough *e*, into which the turnips are laid for cutting, is 4 inches deep, and 3½ feet long, besides the sloping continuation of it in front of the cutters, for throwing off the sliced turnips. The cutting apparatus consists of a grooved frame of iron *f*, in which the compound cutter moves up and down by means of the lever handle *g*. A forked support *h* is bolted by a palm to the further side of the wooden frame, and at the extremity *i* of the fork a swing link is jointed. The lower end of the link is jointed to the extremity of the lever, which is likewise forked, forming its fulcrum; and the gridiron-cutter *k l* is also jointed by its top-bar to the lever at *l*. While the point *l*, therefore, of the cutter moves in a parallel line by its confinement in the grooves of the frame *f*, the fulcrum is allowed to vibrate on the joint *i* of the swing link—thus allowing an easy vertical motion to the cutter through the full range of its stroke. For the better illustration of the cutting apparatus the following figures are given on a larger scale. Fig. 246 is a front view of the cutter-frame, and fig. 247 a horizontal section of the same, including that of the grooved frame *f*. In fig. 247, *a b c* is a section of the grooved frame, with the cutter-frame set in the grooves. The grooves are ½ inch wide, and the cheeks of the frame 1½ inch by ½ inch, making the parts *a b c* 1½ inch square; *a d a* is the bottom bar of the cutting-frame, 1 inch broad, and ¼ inch thick, kneed at the ends to receive the lower ends of the cutting-frame; *e* is the edge view of the slicing-knife, as fixed in the cutter-frame, 4 inches broad, by ⅛ inch thick, and *ffffff* are the ver-

tical or cross cutting-knives, also as seen from above. In fig. 246, *d* again marks the bottom bar of the cutter-frame, *e* is the slicing-knife, and *ffffff* the shanks of the cross cutting-knives,—these are rivetted at top into *e*, and at bottom into *d*; *g g* are the side-bars of the cutter-frame, $\frac{3}{4}$ inch by $\frac{1}{2}$ inch, into which the knife *e* is rivetted, and to which the bar *d* is attached by screw-nuts. The top bar *h* welded to *g g* swells out in the middle, where it is perforated for the joint-bolt of the lever, as seen at *l* in fig. 245, and forms as a whole the gridiron cutter.

Fig. 246.

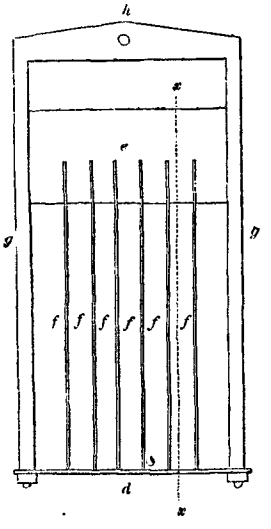


Fig. 249.

Fig. 248.

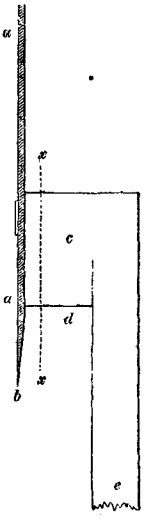
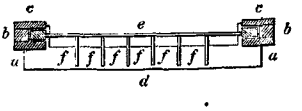
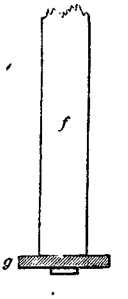


Fig. 247.





THE FRONT AND SIDE VIEWS OF THE CUTTERS OF THE LEVER TURNIP-SLICER.

(1358.) Figs. 248 and 249 are views of the knives on a still larger scale. In the first fig. 248, together with the portion *f* broken off, *a a b* is a cross section of the slicing-knife, and *c d e f* a cross cutting-knife, with its shank; here *a d* is the cutting edge, *c* being the body, and *e f* the shank of the knife. The length of the cutting edge *a d* may vary from $\frac{1}{2}$ to 1 inch, according to the practice of the feeder, the shank *e f* being about $\frac{1}{4}$ inch broad, and the whole

$\frac{1}{8}$ inch thick, except the cutting edge, that alone being sharpened and steeled, as well as the edge of the slicing-knife. The second fig. 249 is a section of a cross cutting-knife on the line *x x*, of fig. 248, together with a part of the shank *e*.

(1359.) The whole length of the cutter-frame, fig. 246, is about 20 inches, apportioned thus,—from the bottom bar *d*, to the edge of the slicing-knife, 12 inches; breadth of the knife, as before, 4 inches; and from the back of the knife to the top of the frame, 4 inches. The width of the frame over all may be 9 inches, and the cross cutters set at from 1 to $1\frac{1}{2}$ inch apart. The grooved frame must of course be constructed to receive and admit of the range of stroke of the cutter-frame. It is to be remarked, that the slicing and cross-cutting is performed with this machine, by one operation, the slicing edge being only $\frac{1}{2}$ inch in advance of the cross-cutters, as at *b* in fig. 248.

(1360.) In operating with this machine, the trough is filled with turnips, and the operator lays hold of the lever *g*, fig. 245, with the right hand, while in his left he holds a short baton. Having raised the lever, and with it the cutter-frame, he pushes a turnip with the baton against the gridiron, and bringing down the lever, the knives cut off a slice, and divide it into oblong pieces; these may partly remain between the backs of the cross cutters, until the succeeding stroke is effected, when the several portions of this slice will discharge those of the first, and so on.

(1361.) The principle of the gridiron-slicer is not confined to this particular mode of construction, nor even to a reciprocating action. Its application to a revolving disc machine was brought forward some years ago by Mr Hay; but owing probably to its greater expense, has been but partially adopted.

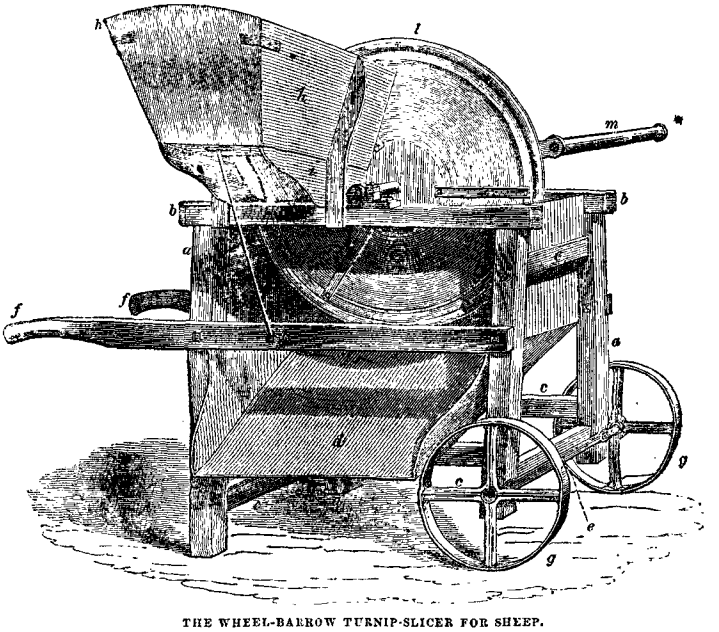
(1362.) The gridiron has also been applied in combination with a revolving crank motion; the gridiron reciprocating, and that in a horizontal position. This modification appears to have originated in Roxburghshire, and appears to possess some advantages, the chief of which is, that, as the roots lie directly *upon* the gridiron, they are more likely to be regularly sliced, than in those machines where the roots lie only *against* the cutters, as in the common vertical disc machines. This machine is essentially a gridiron turnip-slicer, with a reciprocating motion, derived from a rotary motion. The latter is produced by turning a winch handle, the axle of which carries a fly-wheel and two crank levers, or, more properly, the crank of the winch serves for both; the throw of the handle being 15 inches, while that of the cranks is only 7 inches from the axis. A connecting-rod on each side of the machine connects the cranks with the gridiron-cutter, producing the reciprocating motion, which is in the horizontal direction; and to render the motion as easy as possible, the frame of the gridiron moves upon slide-rods. From the circumstance of the motion of the cutter being horizontal, and the turnips lying directly upon the gridiron, it can be easily constructed to cut both ways, that is, with the *out* as well as the *in* stroke; the gridiron for this purpose being furnished at both ends with the slicing knife and the cross-cutting-knives, as described in (1357.) fig. 246. The machinery here described is mounted on a wooden frame, 4 feet 6 inches long, 22 inches wide, and 34 inches high, and over the gridiron is placed a square hopper of wood or of sheet iron, into which the turnips are thrown by an assistant, the machine being driven by a man. A bar of division is placed across in the middle of the hopper, serving as the point of resistance against which the turnips are pressed while the slice is being made; and as the turnips lie on the bars of the gridiron with their full weight, they will for the most part

be in a position to secure a slice of uniform thickness being removed. A slight modification has been made on this machine by placing the gridiron on radius bars, making the cutter move in an arc of about two feet radius, instead of moving in a slide as above described. The radius bars produce a lighter motion, but have no effect on the cutting principle.

(1363.) With a view to economy, the regular slicing of turnips is of more importance than many farmers are aware of. When a part of the turnip is cut into very thin, and even into fragments of slices, a very considerable proportion of it goes to waste. In choosing a turnip-slicer, therefore, one of its points should always be, that it should cut as far as possible to a uniform size, whatever that size may be, and not pass a large proportion of the sliced turnips in thin edged slices, or thin and small fragments of slices.

(1364.) *Wheel Turnip-slicer for Sheep.*—This machine, alluded to in (1355.) has since its introduction undergone many modifications. From being made entirely of wood, it came to be made entirely of iron; but this last being less convenient for moving about, has induced the more general introduction of a disc of cast iron, carrying the cutters, mounted on a wooden frame, which is generally again mounted on wheels like a wheel-barrow. Fig. 250 is a

Fig. 250.

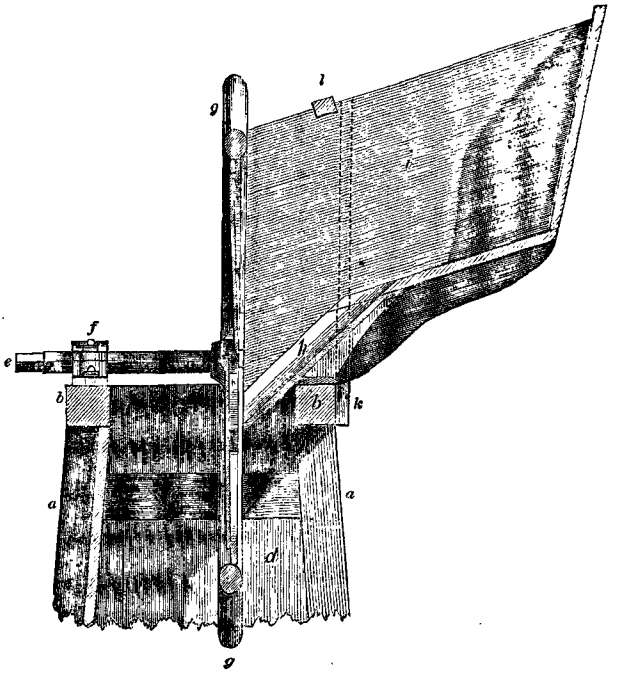


THE WHEEL-BARROW TURNIP-SLICER FOR SHEEP.

perspective of this machine; the wooden frame, which is 36 inches long and 15 inches wide over the posts at top, but spreads a little wider below, is formed with four posts, *a a a a*, one of which is only partially seen in the figure; they are $2\frac{1}{4}$ inches square, and stand about 32 inches in height. The posts are connected on the sides by top-rails *b b*, and two brace-rails *c c*, below, one of which serves to support the spout *d*, which discharges the sliced

turnips. The sides of the frame thus formed are connected by cross-rails above and below, *e e e*, and is there furnished with the handle-bars *f f*, bolted to the posts, and projecting a convenient length beyond them at one end. The barrow-wheels *g g*, of 12 inches diameter, are fitted to an iron axle, which is bolted to the posts in front. The hopper *h* is fixed upon the top-rail by means of a cast-iron sole bolted upon the rail, and is further supported by a wooden bracket at each side, as seen at *i*, and by the iron stay *k*. The slicing-wheel *l* is a disc of cast-iron, carrying three sets of cutters. The disc is mounted on an axle passing through its centre, where it is fixed, and which is supported on bearings placed on the top-rails, and, when worked, it is turned by the winch-handle *m*,

Fig. 251



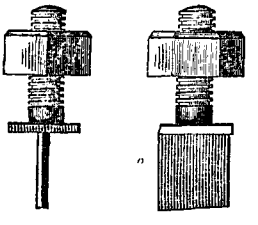
THE SECTION OF THE DISC AND HOPPER OF THE WHEEL-BARROW TURNIP-SLICER.

fixed upon the axle. Fig. 251 is a section of part of this machine, cutting it through the hopper, and the disc, &c., to exhibit some of the parts more in detail. *a a* are parts of two of the posts, *b b* the top-rails, and *c* one of the end-rails of the frame, covered by the boarding *d* of the spout. *f* is one of the pillow block bearings of the axle, the other being kept out of view by the hopper, and the winch-handle is applied at *e*. *g g* is the disc shewn also in section. The sole of the hopper is represented at *h*; it has a flange between *h* and *b*, by which it is bolted to the top-rail *b*; and the sole itself is a cylindrico-concave plate of 12 inches in length at the bottom of the concavity, 9 inches in breadth, and is placed at an angle of 45°. It is also furnished with a flange at

each side, whereby the sides *i* of the hopper are attached to the sole. *k* is the foot of one of the brackets referred to in fig. 250, rising in the position of the dotted lines, for supporting the hopper; and *l* is a light tie-bar, cut by the section, which is applied also to bind the sides of the hopper.

(1365.) The disc or wheel *g g* is a plate of cast-iron, 32 inches in diameter and $\frac{1}{4}$ inch thick, encircled by a heavy ring of the same metal, to give it momentum when in action. The face of the disc is divided into three segmental compartments around a plain and central portion, which is 9 inches diameter. This central part lies in the general plane of the disc, while the segmental portions diverge from the plane in the direction of the circle, causing them to take the form of portions of three separate helical or spiral surfaces of 9 inches in breadth. Their divergence from the plane of the disc does not, however, exceed $\frac{3}{4}$ of an inch at the termination of a segment, or such other space as may be determined upon for the thickness of the slices. By this construction three slits are formed in the disc, passing obliquely through, one at the termination of each segment; and the steel slicing-knife, 12 inches in length and $1\frac{1}{2}$ inch in breadth, is fixed by bolts, so as to form the entering edge of each segment, as seen in fig. 250; the flat face of the knife lying in the general plane of the disc. The terminal edge of each segment lies exactly behind the leading edge of the next, so that, when the slicing-knife is affixed to a leading edge, the edge of the knife covers $1\frac{1}{2}$ inch of the length of the preceding segment. Into the border, which is thus covered by the slicing-knife, are placed from 6 to 10 lancet shaft-cutters, their length being just equal to the width of the slit, and their distance apart proportioned to the number employed, or the breadth at which the turnips are required to be cross cut. The cross-cutters are formed as represented in fig. 252, where *a* is an edge, and *b* a side view of a cutter, with its tail and screw-nut, by which it is fixed into the disc.

Fig. 252.



THE CROSS-CUTTERS OF THE DISC OF THE WHEEL-BARROW TURNIP-SLICER.

(1366.) It will be seen that the action of those compound cutters is very similar to that of the gridiron, the slicing and cross-cutting knives acting together, though the slicing-knife is here also about $\frac{1}{2}$ inch in advance of the cross-cutters; and from the construction of the disc, and arrangement of the feeding-hoppers, the turnip is applied with great regularity and in close contact with the spiral surface of the segments of the disc. The slope of the sole plate in the hoppers gives the turnip a constant tendency to keep in contact with the surface and the cutters, thereby securing regular and good performance by the machine.

(1367.) The wheel turnip-slicer has been applied in a variety of forms, such as cutting on a horizontal direction, the turnips being placed in a hopper right above the disc; and both vertically and horizontally it has been adopted on the locomotive principle, attached in various modes to a cart. Perhaps the most successful of these modes is that produced at the late Show of Implements at Edinburgh, under the auspices of the Highland and Agricultural Society of Scotland, by Mr Kirkwood, Tranent. It is a common slicing disc, mounted on a carriage with two wheels, from the axle of which, and by their own resistance, motion is communicated to the disc by means of a beveled geering. The car-

riage is simply hooked on to a cart which conveys the turnips. The cutting process can be stopped at pleasure by means of the common clutch and lever; and the whole machine being constructed of iron, will be very durable.

(1368.) *Cylinder Turnip-Slicers.*—Turnip-slicers for sheep have been also constructed in a variety of forms with the cutters set in the surface of a cylinder, and been in use for many years. In Roxburghshire it has been long and successfully employed in the locomotive principle, not driven by any machinery from the cart to which it is attached, but being simply hooked to the cart is drawn forward, and the machine being of some weight and moving upon wheels of 3 feet or more in diameter, armed with spikes on their tires to prevent them sliding over the surface of the ground, these give motion to the cutting cylinder, while a boy, sitting on the cart which contains the turnips that are to be cut, throws them into the hopper of the machine, from which they are dropt over the surface of the grass on which the sheep are feeding.

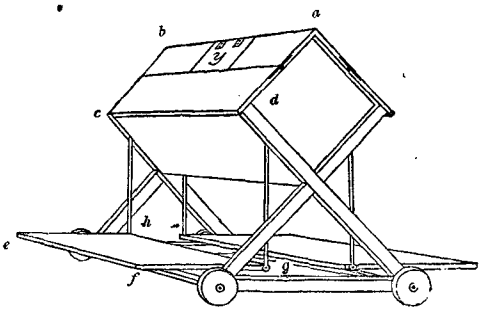
(1369.) A modification of the cylinder-slicer was patented in 1839 by Mr Gardner, Banbury; the principle of the patent lies in the form and arrangement of the cutters, which are set in three divisions upon the surface of the cylinder. The arrangement of the cutters is peculiar and difficult to describe without the aid of a figure. The cylinder on which the cutters are placed is 15 inches in diameter and 12 inches long. Its periphery is divided into 3 compartments, each forming a portion of a spiral, so that the commencement of one and the termination of the next leaves a slit across the periphery, corresponding in some degree with that described on the disc of the wheel turnip-cutter. The original cylindrical slicers had the slicing knife extending in an unbroken edge across the surface of the cylinder, and the cross-cutters placed under and behind it. The improvement on which the patent is based may be described as cutting the slicing-knife into a number of sections, say of 1 inch each in length. The two extreme sections remain in the original position on the cylinder. The section next to that on each side is removed backward upon the surface of the cylinder, say $1\frac{1}{2}$ inch, and there fixed. The section on each side next to those is in like manner set back, and so on, till the whole are placed on the surface of the cylinder. By this arrangement the slicing-cutters form two converging lines, *en echellen*, and this is repeated three times on the periphery of the cylinder. The cross-cutters are formed by a part of the slicing-cutter being bent to a right angle with the former.

(1370.) This cylinder machine, by reason of the cutters acting in succession from their position, *en echellen*, works with great ease and cuts regularly, but, withal, makes the slices too small, and has a tendency to produce waste, though this fault could be easily rectified by enlarging the sections of the knife, and lengthening the cross-cutters. The cylinder is mounted in a wooden frame; and the hopper is so arranged, that the turnip, while being cut, tends always to apply itself to the surface of the cylinder.—J. S.]

(1371.) There is a mode of preserving corn for sheep on turnips which has been tried with success in Fife. It consists of a box like a hay-rack, as in fig. 253, in which the corn is at all times kept closely shut up, except when sheep wish to eat it, and then they get to it by a simple contrivance. The box *a b* contains the corn, into which it is poured through the small hinged lid *y*. The cover *c d*, concealing the corn, is also hinged, and when elevated the sheep have access to the corn. Its elevation is effected by the pressure of the sheep's fore-feet upon the platform *e f*, which, moving as a lever, acts upon the lower

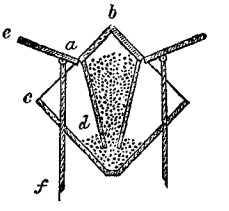
ends of the upright rods *g* and *h*, raises them up, and elevates the cover *c d*, under which their heads then find admittance into the box. A similar apparatus

Fig. 253.



THE CORN-BOX FOR SHEEP ON TURNIPS.

Fig 254.



THE VERTICAL SECTION OF THE INTERIOR OF THE CORN-BOX.

gives them access to the other side of the box. The whole machine can be moved about to convenient places by means of 4 wheels. The construction of the interior of the box being somewhat peculiar, another, fig. 254, is given as a vertical section of it, where *b* is the hinged lid by which the corn is put into the box, whence it is at once received into the hopper *d*, the bottom of which being open, and brought near that of the box, a small space only is left for the corn to pass into the box, the hopper forming the corn-store; *a* is the cover of the box raised on its hinges by the rod *f*, acted upon by the platform *e f*, fig. 253, and when in this position, the sheep put their heads below *a* at *c*, and eat the corn at *d*. Machines of similar construction to this have also been devised to serve poultry with corn at will.* It is a safer receptacle for corn in the field than the open oil-cake trough, fig. 230, but animals require to be made acquainted with it before they will use it with confidence.

(1372.) It is not my purpose to dilate fully on the *diseases* of animals, the symptoms and treatment of which you will find satisfactorily described in the published works of veterinarians; but, nevertheless, it is necessary you should know something of the various diseases animals are liable to, when subjected to the usual treatment of the farm. Were you not warned of the consequences of this, you would not know how to check the progress of disease, but allow it to proceed, until the life of the animal were endangered. It is, however, not desirable that you should consider yourself as a veterinarian, because, not being a professional man, your practical knowledge will necessarily be confined to the cases arising from the casualties of your own stock, and hence your experience will never enable you to become so well acquainted with any disease, nor so many, as the professional man, while you would rely so much upon your own knowledge, crude as it must be, as to undertake the treatment of every case of illness that occurred on your own farm; and thus be prompted to try experiments which may prove dangerous to the safety of the animal. But it is very desirable, because much conducive to your own interest, that you should be acquainted with the most easily recognised symptoms of the commonest diseases

* Prize Essays of the Highland and Agricultural Society, vol. vii. p. 405.

incidental to domesticated animals, and with the general principles of their treatment. If you but knew how to distinguish between local and general affections, and to apply the proper preliminary treatment, you would place the afflicted animal in such a state of safety until the arrival of the veterinary surgeon, as the disease might be easily overcome by him, and your animal restored to health in a short time. Farther than this you have no right to aspire as an amateur veterinarian; for it cannot be too strongly impressed upon you, that before you can be competent to learn the art of healing, you must have an accurate knowledge of the anatomical structure and the physiology of the domestic animals. At the same time, as a branch of general knowledge, veterinary science ought to have your regard, and more especially as your profession places you in a position to occupy the field which affords the most numerous, varied, and interesting cases for veterinary practice. And besides, you should have "some insight," as Professor Dick suggests, "into a subject, with which all who have any pretension to a knowledge of horse-flesh *ought to have some acquaintance*. And if you bear in mind, that, in a compendious view of the principles upon which alone the diseases of domestic animals can be properly treated, you will find an antidote to the quackery by which many valuable animals are sacrificed, and serious expense and vexation occasioned."*

(1373.) On this suggestion, I would notice the complaints of sheep, with the view of letting you see their interesting nature, and of the expediency of your becoming acquainted with their principles. The first which presents itself on sheep, in the low country in winter, is *purging*, occasioned by eating too heartily of the tops, when first confined on turnips. At first, the complaint is not alarming, and the physicing may do good ultimately; but should it increase, or continue beyond the existence of the exciting cause, it may pass into diarrhœa, causing prostration of strength, and at last terminate in dysentery. When the purging is moderate, the pain is inconsiderable; but when aggravated, the mucous membrane, which is the *seat* of the disease, acquires a tendency to inflammation, and griping and colicky pains are the consequence. The disease should not be thought lightly of, but speedily checked. When the green food, as in this case, is obviously at fault, the sheep should be removed to dry pasture until the symptoms disappear. One year, I remember, the white-turnip tops grew so luxuriantly, that when Leicester hoggs were put on in October, they were very soon seized with purging, and the symptoms were much aggravated by alternate falls of rain and raw frosts. The sheep were removed to a rough moory pasture, which had been reserved for the ewes; and while there, I caused the field-workers to switch off the turnip-tops with sickles, and thus got rid of the cause of complaint. In a short time, the hoggs were restored to the turnips, and throve apace; though the wool behind was much injured by the fæcal discharge. And this is one of the losses incurred by such a complaint; and at a season, too, when it would be improper to clip the soiled wool away, to the risk of making the sheep too bare below to lie with comfort upon the cold ground.

(1374.) Sheep are sometimes infested with a species of *louse*, the *Trichodectes sphærocephalus*, characterized by Mr Denny as having the head nearly orbicular, the clypeus rugulose and ciliated with stiff hairs, and the third joint of the antennæ longest and clavate.

(1375.) This animal is perhaps induced to make its appearance by an increase of condition after a considerable period of poverty. It is seldom seen on

* Dick's Manual of Veterinary Science, p. vi. preface.

Leicester sheep, because, perhaps, they are seldom in the state to induce it; but hill-sheep are not unfrequently infested by it, and when so, it is amazing what numbers of the vermin may be seen upon a single sheep, its powers of reproduction seeming prodigious. It lodges chiefly upon and below the neck, where it is most effectually destroyed by mercurial ointment, which should not, however, be applied, *in quantity*, in very cold or in very wet weather; and in these circumstances, tobacco-juice and spirit of tar may be safely used. A quart bottle of decoction of tobacco-leaf, containing a wine glass of spirit of tar, is a useful lotion, for many purposes, for a shepherd to have constantly in his possession. Professor Dick says, that, in slight visitations of the louse, a single dressing of olive oil will cause its disappearance.

(1376.) Another disease to which sheep are subject on passing from a state of poverty to improved condition is *scab*, and hoggs are most susceptible of it. This disease indicates its existence by causing sheep to appear uneasy and wander about without any apparent object; to draw out locks of wool with its mouth from the affected parts, as the disease increases; and, lastly, to rub its sides and buttocks against every prominent object it can find, such as a stone, a tree, a gate-post, the nets, and such like. Mr Youatt says that it arises from an insect, a species of *acarus*;* but whether this be the case or not, one remedy is efficacious, namely, mercurial ointment; a weak one of 1 part of the ointment with 5 of lard for the first stage, and the other a stronger, of 1 part of ointment and 3 of lard, for an aggravated case. The ichorous matter from the pustules adheres to and dries upon the wool, and gets the name of *scurf*, which should first be washed off with soap and water before applying the ointment. The scab is a very infectious disease, the whole flock soon becoming contaminated; but the infection seems to spread, not so much by direct contact, as by touching the objects the animals infected have rubbed against. Its direct effects are deterioration of condition, arising from a restlessness preventing the animal feeding, and loss of wool, large portions not only falling off, but the remainder of the broken fleece becoming almost valueless; and its indirect effects are propagation of the disease constitutionally, and hence the loss to the owner in having a scabbed flock, for no one will purchase from one to breed from that is known to be, or to have been, affected by scab. With regard to the very existence of this disease, it is held disgraceful to a shepherd not to be able to detect its existence at a very early stage, and more so to allow it to make head in his flock, however unobservant he may have been of its outbreak. When it breaks out in a standing flock, it must have been latent in its constitution or in the ground, when the shepherd took charge of it, for some shepherds have only the skill to suppress, not eradicate it; but it is his duty to examine every sheep of his new charge, and of every one newly purchased, before they are allowed to take to their hirsel, and also to make inquiry regarding the previous state of the ground.

(1377.) On soft ground sheep are liable to be affected with *foot-rot*, when on turnips. The first symptom is a slight lameness in one of the fore-feet, then in both, and at length the sheep is obliged to go down, and even creep on its knees, to get to its food. The hoof, in every case, first becomes softened, when it grows mis-shaped, occasioning an undue pressure on a particular part; this sets up inflammation, and causes a slight separation of the hoof from the coronet; then ulcers are formed below where the hoof is worn away, and then at length comes a discharge of fetid matter. If neglected, the hoof will slough off, and the

* Youatt on Sheep, p. 53.

whole foot rot off; which would be a distressing termination with even only one sheep, but the alarming thing is, that the whole flock may be similarly affected, and this circumstance has led to the belief that the disease is very contagious. There is, however, much difference of opinion among store-farmers and shepherds on this point, though the opinion of contagion preponderates. For my part, I never believed it to be so, and there never would have been such a belief, had the disease been confined to a few sheep at a time; but though numbers are affected at one time, the fact can be explained from the circumstance of all the sheep being similarly situate; and as it is the nature of the situation which is the cause of the disease, the wonder is that any escape affection, rather than so many are affected. The first treatment for cure is to wash the foot clean with soap and water, then pare away all superfluous hoof, dressing the diseased surface with some caustic, the spirit of tar and blue vitriol being most in vogue, but Professor Dick recommends butter of antimony as the best; the affected part being bound round with a rag, to prevent dirt getting into it again; and removing the sheep to harder ground, upon bare pasture, and there supplying them with cut turnips. The cure indicates the prevention of the disease, which is careful examination of every hoof before putting sheep upon red land, and paring away all extraneous horn; and should their turnips for the season be upon soft moist ground, let them be entirely sliced, and let the sheep be confined upon a small break at a time, and thus supersede the necessity of their walking almost at all upon it for food. I may mention that sheep accustomed to hard ground, when brought upon that which is comparatively much softer, are most liable to foot-rot, and hence the necessity of frequent inspection of the hoof when on soft ground; and as some farms contain a large proportion of this state of land, frequent inspection should constitute a prominent duty of the shepherd.

(1378.) Erysipelatous complaints occur in winter amongst sheep. "*Wildfire*, it is said," remarks Professor Dick, "generally shews itself at the beginning of winter, and first attacks the breast and belly. The skin inflames and rises into blisters, containing a reddish fluid, which escapes and forms a dark scab. The animal sometimes fevers. Venesection (blood-letting) should be used, the skin should be washed with a solution of sugar of lead, or with lime-water, and physic given, such as salts and sulphur; afterwards a few doses of nitre."*

(1379). There is, perhaps, no circumstance upon which an argument could be better founded in favour of arable land being attached to a hill-farm, for the purpose of raising food to be consumed in stormy weather, than on the fatality of the disease commonly called *braxy*. It affects young sheep, and chiefly those of the Black-faced breed, which subsist upon the most elevated pasture. Indigestion is its primary cause, exciting constipation, which sets up acute inflammation of the bowels, and death ensues. The indigestion is occasioned by a sudden change from succulent to dry food, and the suddenness of the change is imposed by the sudden occurrence of frost and snow, the latter concealing the green herbage which the sheep have been eating; and obliging them to subsist upon the tops of old heather, and twigs and leaves of bushes that overtop the snow. By this account of the origin of the disease, it is obvious, that were stells provided for shelter, and turnips for food, the braxy would never affect young hill-sheep, at least under the circumstances which usually give rise to it. The Ettrick Shepherd thus describes its symptoms:—"The loss of cud is the

* Dick's Manual of Veterinary Science, p. 110.

first token. As the distemper advances, the agony which the animal is suffering becomes more and more visible. When it stands, it brings all its four feet into the compass of a foot; and sometimes it continues to rise and lie down alternately every two or three minutes. The eyes are heavy and dull, and deeply expressive of its distress. The ears hang down, and, when more narrowly inspected, the mouth and tongue are dry and parched, and the white of the eye inflamed. . . . The belly is prodigiously swelled, even so much that it sometimes bursts. All the different apartments of the stomach are inflamed in some degree."* Violent inflammation succeeds, with a tendency to mortification and sinking, so that, after speedy death, the touch of the viscera, and even of the carcass, is intolerable. Its effects are so sudden, that a hogg apparently well in the evening will be found dead in the morning. Cure thus seems almost unavailable, and yet it may be effected, provided the symptoms of the disease are observed in time; when, if blood is drawn freely from any part of the body, such as by notches made across the under side of the tail, from the vein under the eye, and that behind the fore-arm, and a dose of salts administered in warm water, the animal will most probably recover.† But the grand object is *prevention* of the disease by a timely supply of succulent food; and if turnips cannot be obtained, it may be worth the store-master's consideration whether oil-cake should not be given to the sheep along with hay, during a storm. The laxative property of oil-cake is well established, and its carriage to the remotest hill-farm comparatively easy. Mr Fairbairn recommends salt to be given to young sheep, when shifted suddenly from fresh to dry food; and no doubt, as a condiment in support of the healthy action of the stomach, it would prove useful; and more especially in the case of cattle and sheep, the structure of whose digestive organs renders them peculiarly liable to the effects of indigestion; and on this account it would be a valuable assistant to the more nutritious oil-cake. And instead of entirely acquiescing in the Ettrick Shepherd's recommendation "to pasture the young and old of the flocks all together,"—as has been done in Peeblesshire, to the eradication, it is said, of the braxy,—as being in many cases impracticable and attended with no profit, Mr Fairbairn rather observes, "Let the pasture for a hirsel, as was observed before, be as nearly as possible of one soil. To overlook this is a mighty error, and the surest means of making the flock unequal. The heath should also be regularly burned, and the sheep never allowed to pasture *long upon soft grass*." And as a last resource in an attempt to eradicate the disease everywhere, he would have the sheep put on turnips, as "an infallible antidote against the progress of the malady;" and which he has "invariably found gives a settling stroke to the disease."‡ This last remedy doubtless being effective, I would recommend its adoption rather as a preventive than a cure of the disease.

(1380.) The Ettrick Shepherd mentions the existence of 4 kinds of braxy, namely, the *bowel sickness*, the *sickness in the flesh and blood*, the *dry braxy*, and the *water braxy*, all originating in the same cause, producing modified effects, namely, a sudden change of food from succulent to dry, inducing constipation of the bowels and consequent inflammation, and they are all a class of diseases allied in their nature to hoven in cattle, and flatulent colic or botts in horses.

* Hogg's Shepherd's Guide, p. 32.

† The Mountain Shepherd's Manual, p. 13.

‡ A Lammermuir Farmer's Treatise on Sheep in High Districts, p. 194.

33. OF DRIVING AND SLAUGHTERING SHEEP.

" Pierced by Roderick's ready blade,
Patient the sickening victim eyed
The life blood ebb in crimson tide
Down his clogg'd beard and shaggy limb,
Till darkness glazed his eye-balls dim."
SCOTT.

(1381.) Although it is unusual for farmers who possess a *standing* flock—and most farmers who practise the mixed husbandry have one—to dispose of their fat sheep in winter, that is, before the turnips are all consumed; yet as farmers, who, having no standing flock, purchase a flying one every year, of sheep in forward condition, and in such numbers as to consume the turnips allotted to them in a short time, do dispose of their fat sheep in winter, it is proper that you should be made acquainted here with the *driving of sheep upon roads*, and the general practice of the *mutton-trade*. The sheep most forward in condition in autumn are yeld ewes and wethers, the tup-eill ewes being already fat and sold.

(1382.) Sheep are purchased from farmers both by *dealers* and *butchers*. Dealers buy from farmers in wholesale, and sell to butchers in retail; so they constitute a sort of middlemen; but, unlike most middlemen, their avocation is fully as useful to both parties as to themselves, inasmuch as they purchase at once the whole disposable stock of the farmer, and they assort that stock, and present it at the markets which the different classes of their customers, the butchers, are in the habit of frequenting, in the most suitable form. They thus act the part which the wool-staplers do, in assorting the different qualities of wool between the grower and the manufacturer. They buy either at fairs, or on the farmer's own premises. In the former case they pay ready money, and lift the stock immediately; in the latter, they pay at the time the stock is lifted by agreement. In lifting their bargains, they appoint one time among all the places they have purchased, to make up their entire drove; for it is less costly for their people to drive a large one than a small. Dealers chiefly buy at the country fairs, where they have ample choice, and only purchase on the farmer's premises when stock happens to be scarce, and prices likely to advance. Butchers purchase chiefly in the market towns in which they reside, though they also attend fairs, and pick up a few fat lots which will not bear the long journeys of the dealers; and in this case, they pay ready money and lift immediately, as dealers do. But when they

purchase on the farmer's premises, they usually lift so many at a time, according to agreement, and pay only for what they lift. Every farmer should avoid this practice, as every time the butcher comes for his lot the sheep have to be gathered, and the whole handled, that he may take away only those which suit his present purpose; and this commotion is made most probably every week, the whole stock being disturbed by the shouting of men and the barking of dogs, among whom those of the butcher are not the least noisy or the least active. Farmers take their stock either to fairs or market-towns, and there meet the respective sorts of purchasers, the dealers never appearing as purchasers in towns, the butchers there ruling paramount.

(1383.) When a dealer purchases on the farmer's premises, he lifts his lot *at any time of day* that best suits his own arrangements. He begins to lift the first lot in the more distant part of the country, and proceeding on the road in the direction of their destination, he lifts lot after lot until the whole are gathered to the amount of many hundreds. In this way he may lift a lot in the forenoon on one farm, and another in the afternoon on another; and this is a much more satisfactory way for the farmer to dispose of his stock than the one he allows the butcher to adopt. But when a farmer is to drive his own sheep to market, he starts them at a time when the journey will do them the least injury. Sheep should not begin their journey either when too full or too hungry; in the former state they are apt to purge on the road, in the latter they will lose strength at once. The sheep selected for market are the best conditioned at the time, and to ascertain this it is necessary to handle the whole lot and shed the fattest from the rest, and this is best done about midday, before the sheep feed again in the afternoon. The selected ones are put into a field by themselves, where they remain until the time appointed them to start. If there be rough pasture to give them, they should be allowed to use it, and get quit of some of the turnips in them. If there is no such pasture, a few cut turnips on a lea-field will answer. Here all their hoofs should be carefully examined, and every unnecessary appendage removed, though the *firm* portion of the horn should not be touched. Every clotted piece of wool should also be removed with the shears. The sheep should also be marked with *keil*, or *ruddle*, as it is called in England, the ochry-red ironstone of mineralogists, which occurs in abundance near Platte in Bohemia.* The keil-mark is put on the wool and on any part of the body you choose, the purpose being to identify your own sheep in case of any being lost in the

* Jameson's Mineralogy, vol. iii. p. 245.

fair. The parts usually chosen for marking Leicester sheep are top of shoulder, back, rump, far and near ribs. The mark is made in this way;—Take hold of a small tuft of wool at any of the above parts with the right hand fingers, and seize it between the fore and middle fingers of the left hand with the palm upwards, then colour it with the keil, which requires to be wetted, if the wool itself is not damp. Short-woolled sheep are usually marked on the head, neck, face, and rump, or with a bar across the shoulders, and generally too much keil is put upon them. The sheep being thus prepared, should have food early in the morning, and be started on their journey about midday, the season, you will remember, being winter. Let them walk gently away; and as the road is new to them, they will go too fast at first, to prevent which the drover should go before them, and let his dog bring up the rear. In a short distance they will assume the proper speed, about 1 mile the hour. Should the road they travel be a green one, the sheep will proceed nibbling their way onwards at the grass, along both sides; but if a turnpike, especially a narrow one, the drover will require all his attention in meeting and being passed by every class of vehicle, to avoid injury to his charge. In this part of their business drovers generally make too much ado, both themselves and their dogs, and the consequence is, that the sheep are driven more from side to side of the road than is requisite. On meeting a carriage, it would be much better for the sheep were the drover to go forward, instead of sending his dog, and point off, with his stick, the leading sheep to the nearest side of the road, and the rest will follow as a matter of course, while the dog walks behind the flock, and brings up the stragglers. Open gates to fields are sources of great annoyance to drovers, the stock invariably making an endeavour to go through them. On observing an open gate before, the drover should send his dog behind him over the fence, to be ready to meet the sheep at the gate. When the sheep incline to rest, let them lie down. Before night-fall the drover should inquire of lodging for them for the night, as in winter it is requisite to put them in a grass-field, and supply them with a few turnips or a little hay, the roadsides being bare at that season. If turnips or hay are laid down near the gate of the field they occupy, the sheep will be ready to take the road in the morning; but before doing this, the drover should ascertain whether the road is infested with stray dogs, if which be the case, the sheep should be taken to the safest spot and watched. Many dogs that live in the neighbourhood of drove-roads, and more especially village dogs, are in the habit of looking out for sheep to worry, at some distance from their homes. The chief precaution that can be used under such an apprehension is, for the drover to

go frequently through the flock with a light, and be late in retiring to rest, and up again early in the morning. This apprehension regarding dogs is not solely in regard to the loss sustained by worrying, but when sheep have been disturbed by them, they will not settle again upon the road. The first day's journey should be a short one, not exceeding 4 or 5 miles. Upon drove-roads farms will be found at stated distances with food and lodging for the drover and his flock at a moderate charge. Allowing 8 miles a day for a winter-day's travel, and knowing the distance of your market by the destined route, the sheep should start in good time, allowance being made for unforeseen delays, and one day's rest near the market.

(1384.) The *farmers' drover* may either be his shepherd, or a professional drover hired for the occasion. The shepherd knowing the flock makes their best drover, if he can be spared so long from home. A hired drover gets 2s. 6d. a-day of wages, besides travelling expenses, and he is intrusted with cash to pay all the necessary dues incidental to the road and markets, such as tolls, forage, ferries, and market custom. A drover of sheep should always be provided with a dog, as the numbers and nimbleness of sheep render it impossible for one man to guide a capricious flock along a road subject to many casualties; not a young dog, who is apt to work and bark a great deal more than necessary, much to the annoyance of the sheep, but a knowing cautious tyke. The drover should have a walking-stick, a useful instrument at times in turning a sheep disposed to break off from the rest. A shepherd's plaid, he will find to afford comfortable protection to his body from cold and wet, while the mode in which it is worn leaves his limbs free for motion. He should carry provision with him, such as bread, meat, cheese, or butter, that he may take luncheon or dinner quietly beside his flock while resting in a sequestered part of the road, and he may slake his thirst in the first brook or spring he finds, or purchase a bottle of ale at a roadside ale-house. Though exposed all day to the air, and even though he feel cold, he should avoid drinking spirits, which only produce temporary warmth, and for a long time after induce chilliness and languor. Much rather let him drink ale or porter during the day, and reserve the allowance of spirits he gives himself until the evening, when he can enjoy it in warm toddy beside a comfortable fire, before retiring to rest for the night. The injunction to refrain from spirits during the day I know will sound odd to the ear of a Highland drover; but though a dram may do him good in his own mountain-air, and while taking *active* exercise, it does not follow that it will produce equally good effects on a drove-road in the low country in winter, in raw and foggy weather. I believe the

use of raw spirits does more harm than good to all drovers who indulge in the practice. He should also have a good knife, by which to remove any portion of horn that may seem to annoy a sheep in its walk; and also a small bottle of a mixture of tobacco-liquor and spirit of tar, with a little rag and twine, to enable him to smear and bandage a sheep's foot, so as it may endure the journey. He should be able to draw a little blood from a sheep in case of sickness. Should a sheep fail on the road, he should be able to dispose of it to the best advantage; or becoming ill, he should be able to judge whether a drink of gruel or a handful of common salt in warm water may not recover it so as to proceed; but rather than a lame or jaded sheep should spoil the appearance of the flock, it should be disposed of before the flock is presented in the market.

(1385.) The many casualties incidental to sheep on travel, more especially in winter, require consideration from the farmer, before undertaking to send his stock to a distant market town, in preference to taking them to a fair, or accepting an offer for them at home. A long journey in winter will cost at least 1s. a-head, and their jaded appearance may have the effect of lowering their market price 2s. or 3s. a-head more. Under any circumstances, when you have determined on sending your sheep to a market-town, it is, I believe, the best plan, after the journey, to entrust them to a salesman, rather than stand at market with them yourself, as you cannot know the character of the buyers so well as he does, nor can you know what class of purchasers your lot may best suit. The convenience attending the employment of a salesman is now generally felt, because it not only saves the personal annoyance of attending a market, but your money is remitted to you through a bank in the course of the day. The only precaution requisite in the matter is to become acquainted with a salesman of judgment, for as to honesty, if he have not *that*, he is of course quite worthless. In attending country fairs the case is otherwise, there being no salesman, you yourself must stand by your lot. Before attending the fair, you should make up your mind what to ask for your stock, in accordance with the current market prices; but, notwithstanding this, you may come away with more or less cash than you anticipated, because the actual state of *that* market will be regulated by the quality and quantity of the stock brought forward, and by the paucity or numbers of buyers who may appear. After your sheep are fairly placed you should inquire of friends of the state of prices before you sell, and on doing this you will frequently find the market in a most perplexing state from various causes. Thus, there may be too many sheep for the buyers, when the market will be dull, and

remain so all day. On the other hand, the stock may be scanty for the buyers, when a briskness may start in the morning and continue even till the whole stock are sold off. There may be briskness in the morning, the buyers purchasing, dulness at midday, buyers declining, and briskness again in the afternoon, buyers again purchasing. There may be excessive dulness in the morning, occasioned by the buyers lying off and beating down prices, and, finding they cannot succeed, buy briskly all afternoon. There may be dulness in the morning, arising from the dealers finding the condition of the stock below their expectation. The markets are never better for the farmer than when they begin brisk early in the morning, and the stock are all sold off early. These are the vicissitudes of a market; they are interesting, demand attention, and are worth examination. You will frequently observe a trifling circumstance give a decided tone to a market. A dealer, for instance, who generally buys largely, and having bought for many years respectably in that particular fair, will mark the prices of the day by his purchases; so that other people, particularly sellers, observing the prices given by him, will sell briskly and with confidence. There is no use, at any time, of asking a much higher price than the intrinsic value of your stock, or than you will willingly take, for, although your stock may be in particularly fine condition, and of good quality, and therefore worth more than the *average* price of the market, still their value must conform to the *rate* of the market, be it high or low, and it is not in your power to control it, though, if prices dissatisfy you, you have it in your power to take your stock home again. There is a common saying applicable to all public markets, and is now received as a maxim, because indicating the truth, that "the first offer is the best," that is, the first offer from a *bona fides* buyer, for there are people to be found in all markets who, having no serious intention of buying at market price, make a point of offering considerably below it, with the view of catching a bargain from a greenhorn, or from one tired of standing longer in the fair, and they sometimes succeed in their wishes; but such people are easily discovered, and therefore cannot *deceive* any but inexperienced sellers.

(1386.) There are certain *rules* which, by tacit consent, govern the principles upon which all public markets of stock are conducted, and they are few and simple. There is a *custom* payable for all stock presented at fairs, exigible by the lord of the manor, or other recognised authority. After entering the field, your stock can take up any unoccupied position you choose, appointed for the particular kind of stock you have to shew. No one, on pretence of purchasing, has a right to inter-

fere with a lot which is under inspection by another party. Neither have you any right to shew your lot to more than one party at a time, unless each party consent to it. When a bargain is made, there is no necessity for striking hands, or exchanging money, as an earnest of it. When a bargain is made, a time may be stipulated by the purchaser for lifting the stock; and until they are delivered to him, or his accredited agents, they continue at the risk of the seller. When counted over before the purchaser, the price becomes immediately due. When the money is paid, there is no obligation on the seller to give a discount off the price, or a *luck-penny*, as it is termed; but purchasers sometimes make offers, in a way to humour the prejudices of the seller, that is, they offer the price demanded, on condition of getting back a certain sum, or amount of luck-penny, to bring the price down to their own ideas; in such a case, when such an offer is accepted, the seller must return the luck-penny conditioned for, when he receives the money. Sometimes, when parties cannot agree as to price, the offerer proposes to abide by the decision of a third party, but in doing this, you virtually relinquish your power over your own stock. Sometimes bills, and bank-post-bills, are tendered by dealers in part or entire payment of what they purchase; but it is in your power to refuse any form of cash but the legal tender of the country, such as Bank of England notes, or gold, or silver. If a bill of exchange or promissory note is proffered instead of ready money, you are quite entitled to refuse the bargain; for the usage of trade in a fair implies the condition of ready money;* or you may demand a higher price to cover the risk of the bill being dishonoured. The notes of any bank you know to be good you will of course not refuse. After the stock are delivered, they are at the risk of the purchaser. Some dealers' *top's-men*, that is, the men who take charge of their master's lots after delivery, demand a gratuity for their trouble, which you are at liberty to refuse. All these rules, in as far as relates to money, and the delivery of stock, apply to the stock purchased by dealers on your own farm. When you *purchase* stock at a fair, people will be found on the ground willing to render your drover assistance in taking them out of it, and of setting them fairly on the road. Such people are useful on such occasions, as it may happen, especially in the case of sheep, that one or more may break away from their own flock, and mix with another, when there may not only be difficulty in shedding them out, but those into whose lot yours have strayed may shew unwil-

* The Farmer's Lawyer, p. 143.

lingness to have their stock disturbed for your sake, though it is in your power to follow your strayed stock, and claim it anywhere by the wool-mark.

(1387.) The way that fat is laid on sheep while on turnips, and the mode of judging of a fat sheep, are these :—Hoggs, when put on turnips in winter, are generally lean ; for although they had been in good condition as lambs when weaned from their mothers in summer, their growth in stature afterwards is so rapid, that their flesh is but little intermixed with fat. For the first few weeks on turnips, even in the most favourable circumstances as to quality of food, warmth of shelter, dryness of land, and pleasantness of weather, they make no apparent advancement in condition ; nay, they rather seem to fall off, and look clapped in the wool, and indicate a tendency to delicacy, in consequence, I suppose, of the turnips operating medicinally on their constitution as an alterative, if not as a laxative; but immediately after that trying period for young sheep, especially trying in bad weather, is past, when the grass has completely passed through them, and the stomach and intestines have become accustomed to the more solid food of the turnip, their improvement is marked, the wool seeming longer and fuller, the carcass filled out, the eyes clear and full, and the gait firm and steady. They then thrive rapidly, and the more rapidly the drier the weather.

(1388.) The formation of fat in a sheep destined to be fattened, commences in the inside, the *net* of fat which envelopes the intestines being first formed, and a little deposited around the kidneys. After that, fat is seen on the outside, and first upon the end of the rump at the tail-head, which continues to move on along the back, on both sides of the spine or backbone to the bend of the ribs, to the neck. Then it is deposited between the muscles, parallel with the cellular tissue. Meanwhile, it is covering the lower round of the ribs descending to the flanks, until the two sides meet under the belly, from whence it proceeds to the brisket or breast in front, and the shaw or cod behind, filling up the inside of the arm-pits and thighs. While all these depositions are proceeding on the outside, the progress in the inside is not checked, but rather increased, by the fattening disposition encouraged by the acquired condition ; and hence, simultaneously, the kidneys become entirely covered, and the space between the intestines and lumbar region or loin gradually filled up by the net and kidney fat. By this time, the cellular spaces around each fibre of muscle is receiving its share, and when fat is deposited there in quantity, it gives to meat the term *marbled*. These interfibrous spaces are the last to receive a deposition of fat ; but after this

has begun, every other part simultaneously receives its due share, the back and kidneys receiving the most, so much so that the former literally becomes *nicked*, as it is termed; that is, the fat is felt through the skin to be divided into two portions, from the tail-head along the back to the top of the shoulder, the tail becoming thick and stiff, the top of the neck broad, the lower part of each side of the neck towards the breast full, and the hollows between the breastbone and the inside of the fore-legs, and between the cod and the inside of the hind thighs, filled up. When all this has been accomplished, the sheep is said to be *fat* or *ripe*.

(1389.) When the body of a fat sheep is entirely overlaid with fat, it is then in the most valuable state as mutton; but few sheep lay on fat entirely over their body, one laying the largest proportion on the rump, another on the back; one on the ribs, another on the flanks; one on the parts adjoining the fore-quarter, another on those of the hind-quarter; one more on the inside, and another more on the outside. Taking so many parts, and combining any two or more of them together, you may expect to find, in a lot of fat sheep, a considerable variety of condition, and yet any one is as ripe in its way as any other.

(1390.) Taking these data for your guide, you will be able to detect by handling the state of a sheep in its progress towards ripeness. A *ripe* sheep, however, is easily known by the *eye*, by the fulness exhibited in all the external parts of the particular animal. It may exhibit wants in some parts when compared with others, but you easily see that these parts would never become so ripe as the others; and this arises from some *constitutional* defect in the animal itself, because, if this were not so, there is no reason why all the parts should not be alike ripe. Whence this defect arises remains to be considered afterwards. The state of a sheep that is obviously not ripe cannot altogether be ascertained by the eye; it must be *handled*, that is, it must be subjected to the scrutiny of the hand. Now, even in so palpable an act as handling discretion is requisite. A full-looking sheep need hardly be handled on the rump, for he would not seem so full unless fat had been first deposited there. A thin-looking sheep, on the other hand, should be handled on the rump, and if there be no fat there, it is useless handling the rest of the body, for assuredly there will not be so much as to deserve the name of fat. But between these two extremes of condition there is every variety to be met with; and on that account examination by the hand is the rule, by the eye alone the exception; but the hand is much assisted by the eye, whose acuteness detects deficiencies and redundancies at once. In handling a sheep the points of the fingers are chiefly employed, and the accurate knowledge conveyed by them through prac-

tice of the true state of condition is truly surprising, and settles a conviction in the mind that some intimate relation exists between the external and internal state of an animal. And hence this practical maxim in the judging of stock of all kinds, that no animal will appear *ripe to the eye*, unless as much fat had previously been laid on in the inside as his constitutional habit will allow. The application of this rule is easy. Thus, when you find the rump nicked on handling, you may expect to find fat on the back; when you find the back nicked, you would expect the fat to have proceeded to the top of the shoulder and over the ribs; and when you find the top of the shoulder nicked, you would expect to find fat on the under side of the belly. To ascertain its existence below, you will have to *turn him up*, as it is termed; that is, the sheep is set upon his rump with his back down and his hind-feet pointing upwards and outwards. In this position you see whether the breast and thighs are filled up. Still all these alone would not let you know the state of the inside of the sheep, which should, moreover, be looked for in the thickness of the flank; in the fulness of the breast, that is, the space in front from shoulder to shoulder towards the neck; in the stiffness and thickness of the root of the tail, and in the breadth of the back of the neck. All these latter parts, especially with the fulness of the inside of the thighs, indicate a fulness of fat in the inside; that is, largeness of the mass of fat on the kidneys, thickness of net, and thickness of layers between the abdominal muscles. Hence the sole object of feeding sheep on turnips seems to be to lay *fat* upon all the bundles of fleshy fibres, called muscles, that are capable of acquiring that substance; for as to bone and muscle, these increase in weight and extent independently of fat, and fat only increases their magnitude.

(1391.) I have spoken of the *turning up* of a fat sheep; it is done in this way. Standing on the *near* side of the sheep, that is, at *its* left side, put your left hand under its chin, and seize the wool there, if rough, or the skin, if otherwise; place your knees, still standing, against its ribs, then bowing forward a little, extend your right arm over the far loin of the sheep, and get a hold of its flank as far down as you can reach, and there seize a large and firm hold of wool and skin. By this, lift the sheep fairly off the ground, and turning its body towards you upon your left knee under its near ribs, place it upon its rump on the ground with its back to you, and its hind feet sticking up and away from you. This is an act which really requires strength, and if you cannot lift the sheep off the ground, you cannot turn it; but some people acquire a sleight in doing it, beyond their physical powers. I believe the art consists in jerking the sheep off its feet at once, before it suspects what you are

going to do; for if you let it feel that you are about to lift it as a dead weight, the probability is, that you will not be able to make it lose hold of the ground, as it is surprising how dexterously sheep contrive, in the circumstances, to retain hold of the ground with the point of the hoof of the *near hind-foot*, which, if you cannot force away, you cannot turn the sheep. I remember seeing 4 shepherds defeated in the attempt to turn 5 dinmonts belonging to the late Mr Edward Smith, Marledown, Northumberland. None of the shepherds, even the longest and strongest, could turn all the 5 sheep, and one of them, a short though stout man, could not turn one of them, they were so broad in the back, so round and heavy. The ability to turn a sheep is not to be regarded as a feat in a shepherd, but a necessary act in connection with many important operations, as you shall see afterwards.

(1392.) Sheep are easily *slaughtered*, and the operation is unattended with cruelty. They require some preparation before being deprived of life, which consists of food being withheld from them for not less than 24 hours, according to the season. The reason for fasting sheep before slaughtering, is to give time for the paunch and intestines to empty themselves entirely of food, as it is found when an animal is killed with a full stomach, the meat is more liable to putrefy, and not so well flavoured; and as ruminants always retain a large quantity of food in their intestines, it is reasonable they should fast somewhat longer to get quit of it than animals with single stomachs. Sheep are placed on their side on a stool, called a *killing stool*, to be slaughtered, and requiring no fastening with cords, are deprived of life by a thrust of a straight knife through the neck, between its bone and the windpipe, severing the carotid artery and jugular vein of both sides, from which the blood flows freely out, and the animal soon dies. The skin, as far as it is covered with wool, is taken off, leaving that on the legs and head, which are covered with hair, the legs being disjointed by the knee. The entrails are removed by an incision along the belly, after the carcass has been hung up by the tendons of the houghs. The net is carefully separated from the viscera, and rolled up by itself; but the kidney fat is not then extracted. The intestines are placed on the inner side of the skin until divided into the *pluck*, containing the heart, lungs, and liver; the *bag*, containing the stomach; and the *puddings*, consisting of the viscera or guts. The bag and guts are usually thrown away, that is, buried in the dunghill, unless when the bag is retained and cleaned for haggis. The pluck is either fried or made into haggis. The skin is hung over a rope or pole under cover, with the skin-side uppermost, to dry in an airy place.

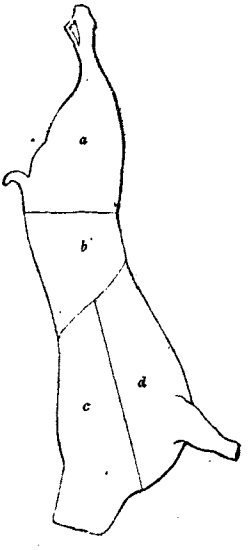
(1393.) Butchers have various ways of displaying a carcass of mutton. Some fold back the flaps of the flanks, and secure them with wooden skewers, and fully expose the interior of the carcass to view. Others merely distend them with a long stretcher of wood; whilst some, folding them back, distend them with the stretcher placed across the back. Some distend the breast with a stretcher. Others pin the tail down to the rump with a skewer. Whilst many cut a cross with the knife upon the skin of the shoulder, which, contracting, shews the fat underneath; and to make the whiteness of the fat appear more conspicuous, the part of the skin upon which the cross is formed is first reddened with a lock of wool dipt in blood. Figures are even carved on the neck and other parts of the carcass. All these expedients are useless in themselves, and injurious to the meat, inasmuch as they distort the shape of the pieces when cut out, and should therefore be abandoned, and the carcass allowed to hang intact after the entrails have been entirely removed; with the exception, perhaps, of distending the flaps of the flank a little with a small stretcher, in order to allow the air to dry the inside of the carcass. The membranous covering of the outside of the carcass has different colours, that of the shoulder and flanks being bright red, and along the back white. The redness is higher coloured in Black-faced sheep than in any other breed I have observed; and gives the meat a tempting appearance.

(1394.) The carcass should hang 24 hours in a clean, cool, airy, dry apartment, before it is cut down. I say *cool* and *dry*, for if warm the meat will not become firm, and if damp a clamminess will cover it, and will never feel dry, and have a fresh clean appearance. The carcass is divided in two by being sawn right down the back-bone. The kidney fat is then taken out, being only attached to the peritoneum by the cellular membrane, and the kidney is extracted from the *suet*,—the name given to sheep tallow in an independent state.

(1395.) In almost every town there is a different way of cutting up a carcass of mutton; and it being here impossible to advert to them all, I shall select those of Edinburgh and London, and distinguish them as the Scotch and English modes. Although the English mode is upon the whole preferable, having been adopted to suit the tastes of a people long acquainted with domestic economy, it must nevertheless be admitted that meat is cut up in Scotland in a cleanly and workman-like manner; but on the other hand, it will not be denied by those, who have observed for themselves, that the beauty and cleanliness of meat, as exhibited in London, call forth the admiration of every connoisseur. The Scotch mode is represented in fig. 255, where, in the hind-quarter, *a* is the *jigot*

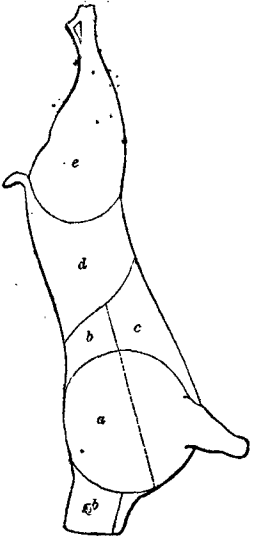
and *b* the *loin*, and, in the fore-quarter, *c* the *back-ribs* and *d* the *breast*. It will be observed that the jigot is cut with a part of the haunch or rump, and the fore-quarter right through the shoulder into 2 pieces. The English mode is represented in fig. 256, where, in the fore-quarter, *a* is the shoulder, *b* and *b* the neck, and *c* the breast after the shoulder

Fig. 255.



THE SCOTCH MODE OF CUTTING UP A CARCASS OF MUTTON.

Fig. 256.



THE ENGLISH MODE OF CUTTING UP A CARCASS OF MUTTON.

is removed; and, in the hind-quarter, *d* is the loin and *e* the leg. The leg here is cut short, without any of the haunch, like a ham; and the shoulder is preserved whole.

(1396.) The jigot *a*, fig. 255, is the handsomest and most valuable part of the carcass, and on that account fetches the highest price. It is either a roasting or a boiling piece. Of Black-faced mutton it makes a fine roast, and the piece of fat in it called the *Pope's eye*, is considered a delicate *morceau* by epicures. A jigot of Leicester, Cheviot, or Southdown mutton makes a beautiful "boiled leg of mutton," which is prized the more the fatter it is, as this part of the carcass is never overloaded with fat. The loin *b* is almost always roasted, the flap of the flank being skewered up, and it is a juicy piece. For a small family, the Black-faced mutton is preferable; for a large, the Southdown and Cheviot. Many consider this piece of Leicester mutton roasted as too rich, and when warm, this is probably the case; but a cold roast loin is an excellent summer dish. The back-ribs *c* is divided into two, and used for very

different purposes. The fore-part, the neck, is boiled, and makes sweet barley-broth; and the meat, when well boiled, or rather the whole pottage simmered for a considerable time *beside* the fire, eats tenderly. The back-ribs make an excellent roast; indeed, there is not a sweeter or more varied one in the carcass, having both ribs and shoulder. The shoulder-blade eats best cold, and the ribs warm. The ribs make excellent chops. The Leicester and Southdowns afford the best mutton-chops. The breast *d* is mostly a roasting piece, consisting of rib and shoulder, and is particularly good when cold. When the piece is large, as of Southdown or Cheviot, the gristly part of the ribs may be divided from the true ribs, and helped separately. The breast is an excellent piece in Black-faced mutton, and suitable to small families, the shoulder being eaten cold, while the ribs and brisket are sweet and juicy when warm. This piece also boils well; or, when corned for 8 days, and served with onion sauce, with mashed turnip in it, there are few more savoury dishes at a farmer's table. The shoulder *a*, fig. 256, is separated before being dressed, and makes an excellent roast for family use, and may be eaten warm or cold, or corned and dressed as the breast mentioned above. The shoulder is best from a large carcass of Southdown, Cheviot, or Leicester, the Black-faced being too thin for the purpose; and it was probably because English mutton is usually large that the practice of removing it originated. The neck-piece *b b* is partly laid bare by the removal of the shoulder, the fore-part being fitted for boiling and making into broth, and the best end for roasting or broiling into chops. On this account this is a good family piece, and in such request among the tradesmen of London that they prefer it to any part of the hind-quarter. Heavy mutton, such as the Leicester, Southdown, and Cheviot, supply the most thrifty neck-piece. The breast *c* is much the same sort of piece as in the Scotch method, but the ribs are here left exposed at the part from which the shoulder has been removed, and constitute what are called the *spare ribs*, which may be roasted, or broiled, or corned. The back end of the breast makes a good roast for ordinary use. The flap of the loin left attached to this piece may be used in making broth. The loin *d* is a favourite roast in a family; and when cut double, forming the chine or saddle, it may grace the head of the table of any public dinner. Any of the kinds of mutton is large enough for a saddle; but the thicker the meat, of course the larger the slice. The leg *e* is cut short and roasted. When cut long, taking in the hook-bone, it is similar to a haunch of venison, and roasted accordingly. A fat Black-faced wether yields a good haunch.

(1397.) The different sorts of mutton in common use differ as well in

quality as in quantity. The flesh of the Leicester is large, though not coarse-grained, of a lively red colour, and the cellular tissue between the fibres contains a considerable quantity of fat. When cooked it is tender and juicy, yielding a red gravy, and having a sweet rich taste; but the fat is rather too much and too rich for some people's tastes, and can be put aside; and it must be allowed that the lean of fat meat is far better than lean meat that has never been fat. Leicester sheep generally attain to heavy weights, hoggs reaching 18 lb. or 20 lb., and dinmonts 30 lb. per quarter; but the 5 dinmonts which I mentioned before as having defeated the shepherds in turning up, were 55 lb. a quarter overhead, when killed at Newcastle in November, a few weeks after they were shewn.

(1398.) Cheviot mutton is smaller in the grain, not so bright of colour, with less fat, less juice, not so tender and sweet, but the flavour is higher and the fat not so luscious. The weight attained by a hogg may be taken at 14 lb. or 15 lb., and by a wether at 22 lb.; but Mr Fairbairn mentions having fattened 5 wethers in 1818 which averaged 30 lb. a quarter.*

(1399.) Black-faced mutton is still smaller in the grain, of a darker colour, with still less fat, but more tender than the Cheviot, and having the highest flavour of all. The ordinary weight of a fat wether is about 18 lb. or 20 lb. a quarter; but I remember seeing a lot of 5-year-old Black-faced wethers, exhibited at the first Show of the Highland and Agricultural Society at Perth, belonging to Lord Panmure, that averaged 40 lb. a quarter.

(1400.) The mutton of Southdowns is of medium fineness in grain, colour pleasant red, fat well intermixed with the meat, juicy, tenderer than the Cheviot, and of pleasant though not of so high a flavour as the Blackfaced. The ordinary weight may be from 16 lb. to 22 lb. a quarter, but 3 wethers exhibited by Mr Grantham at the Show of the Smithfield Club in 1835, weighed, on the average, 41½ lb. a quarter.†

(1401.) Tup-mutton of any breed is always hard, of disagreeable flavour, and in autumn not eatable. The mutton of old ewes is dry, hard, and tasteless, but of young well enough flavoured, but still rather dry. Hogg-mutton is sweet, juicy, and tender, but flavourless. And wether-mutton is the meat in perfection, according to its kind.

(1402.) The average quantity of fat afforded by each sheep of every class, sold in any given market in Scotland, is perhaps not great. In Glasgow, for example, where heavy animals of all sorts are generally

* A Lammermuir Farmer's Treatise on Sheep in High Districts, p. 123.

† Youatt on Sheep, p. 236.

sold, the fat afforded by all the sheep,—consisting chiefly, I presume, of Cheviot and Black-faced,—exclusive of lambs, amounting to 57,520 head, sold in 1822, was only, on the average, 4 lb. 13 oz. per head.* From 8 lb. to 12 lb. is the ordinary quantity obtained from *Leicester* sheep slaughtered on farms of good land; and in Edinburgh, I find that 7 lb. is considered an average from Black-faced and Cheviot sheep, which shews that the quality of mutton sold there is better than that in Glasgow.

(1403.) As you may frequently hear it remarked in the course of your experience as a farmer, that 5-year-old mutton is the best, it is worth while considering whether the case can be so. Two subjects of inquiry immediately present themselves on hearing this remark; one, Whether sheep require 5 years to put them in condition for use? and the other is, Whether it is treating them properly, to postpone putting them in condition for use until they shall attain the age of 5 years? If truth is implied in the first inquiry, then that breed of sheep must be very unprofitable which takes 5 years to attain its best state; but there is no breed of sheep in Great Britain which requires 5 years to bring it to perfection. Therefore, if truth is implied in the second inquiry, then it must be folly to restrain sheep coming to perfection until they have attained the age of 5 years. It is not alleged by the lovers of 5-year-old mutton that it bestows profit on the farmer, for the allegation only insists on its being best at that age. But such an allegation involves one of two absurd conditions in agriculture; namely, the keeping a breed of sheep that cannot, or the keeping of one that you should not allow to attain to perfection before it is 5 years. Either of these conditions makes it obvious, that mutton cannot be in its *best* state at 5 years. The fact is, the idea of 5-year-old mutton being superexcellent, is founded on a prejudice, which probably arose from this circumstance:—Before winter-food which could maintain the condition on stock that had been acquired in summer, was discovered, sheep lost much of their summer-condition in winter, and of course an oscillation of condition occurred year after year until they attained the age of 5 years; when their teeth beginning to fail, would cause them to lose their condition the more rapidly. Hence, it was expedient to slaughter them not exceeding 5 years of age; and no doubt, at that age mutton would be high flavoured that had been exclusively fed on natural pasture and natural hay. But such treatment of sheep cannot now be justified on the principles of modern practice; because both reason and taste concur in mutton being at its *best* when-

* Cleland's Account of the Highland and Agricultural Society's Show at Glasgow in 1828, p. 40.

88490

ever sheep attain their *perfect state of growth and condition*, not their largest and heaviest; and as one breed attains its perfect state at an earlier age than another, its mutton attains its best before another breed attains *its* best state, although its sheep may be older; but taste alone prefers one mutton to another, even when both are in their best state, from some peculiar property. The Black-faced sheep, for instance, is preferred by many, because of the flavour of its mutton; and this property it has most probably acquired from the heathy pasture upon which it is brought up. But if flavour alone is to decide the point, the Welsh mutton is much the superior. So far as juiciness is concerned, a Leicester hogg has more of it than any Black-faced sheep; and the darkness of the flesh of the latter arises solely from the breed, as it seems to form the connecting link, in this country, between the sheep and the goat, the latter of which always has dark-coloured flesh. Judged by the scale of perfection of growth, Leicester mutton is best in the dinmont; and as it may require 5 years to bring a Black-faced wether to that state when constantly confined upon the hills, Black-faced mutton may then be considered in its best state, *because* it is 5-year-old, but so far from being in the condition it would have attained had it been brought down to the low country when a lamb and fed upon the best food, it would still be lean, and, of course, not in a state of perfect growth; whereas, in the low country, it would attain perfection of growth at 3 years, and then its mutton must be at its *best;* for beyond that age,—that is, if kept to 5 years on such food,—it would become too fat, and lose much of its delicacy. The cry for 5-year-old mutton is thus based on very untenable grounds.

(1404.) *Markets* for sheep are held in all large towns, and the butchers in the small ones supply themselves from the farmers. The Edinburgh weekly market, on Wednesday, supplies the Black-faced mutton in perfection, and the Cheviot is also very good. In Morpeth, on Wednesdays, are to be seen Leicesters in the highest state of condition, which are bought up with avidity for the colliers around Newcastle. In London, on Mondays, the Southdowns are seen in great perfection, this being the favourite mutton of the capital.

(1405.) A great trade in the transmission of live-stock and meat from the east coast of Scotland to London, has arisen since the establishment of steam navigation. From inquiry, I found that, in the year ending May 1837, there were shipped 4221 old sheep, and 11,672 barrel-bulk of meat, chiefly mutton, which, at 2½ cwt. per barrel-bulk, give 29,175½ cwt.* The meat is sent by butchers at the different shipping ports, and

* See an article on the preparation of live-stock and meat for exportation by steam, in

the live-stock by dealers, butchers, and farmers. When you determine to send your stock to London, you should, in the first place, establish a correspondence with a live-stock salesman, who will pay all charges on board ship and at market, and remit the balance in course of post. The charges consist of freight, which for sheep is 3s. 6d. a-head, commission, hay or grass on board, dues and wharfage, hay or grass on shore, and driving to market. You will, of course, never ship meat, but you should, nevertheless, be well acquainted with all the pieces into which a carcass of beef or mutton is cut up, that you may know whether your stock is of the description to supply the most valuable pieces of meat; for, without this knowledge, unless, in short, you know the wants of a market, you cannot know whether you are supplying its requirements, or whether your stock ought to realize the top prices.

(1406.) On the supposition that you send sheep to London by steam on your own account, they should be of the following description, to command the best prices; and unless they are so, you had much rather dispose of them at home. They should be ripe, compact, and of light weight; carrying a large proportion of lean on the back, loins, and shoulders, with a full round leg, and handsome carcass. Such, from 14 lb. to 20 lb. a-quarter, will take readily, but they will draw the most money at from 16 lb. to 18 lb. The nearer in their form and quality they approach the Southdowns, the more likely to command top prices. True-bred Cheviots, and the Black-faced Linton breed, approach very near to the Southdown, and command as high a price. Half-breds, between Leicester tups and the above sorts of Cheviot and Black-faced ewes, form valuable sheep. The old Black-faced breed are too *thin*, and therefore styled *goaty* in Smithfield, and when only half-fat, or *half-meated*, as the condition is there termed, fetch middling prices, however good their flavour may be. Pure-bred Leicesters are too *fat*, unless sent young, and not exceeding 20 lb. a-quarter, but above that weight, fetch inferior prices, so much so, that a difference of only 1d. per lb. may perhaps constitute all the difference between a profit and loss on their export. This last remark applies to every other breed, and shews the expediency of only exporting the best form of sheep.

(1407.) Never attempt to drive stock on foot on your own account to a distant market, when you have steam-conveyance to the place of destination. A simple comparison of the results of the two methods of travelling will shew you at once the advantage of steam-conveyance. It has been ascertained, that a journey of 400 miles on land causes a loss of

vol. viii. p. 241 of the Quarterly Journal of Agriculture, drawn up by me on information derived from Mr James Dickson, in Orkney, who has had great experience in every matter relating to meat and live-stock; and also from other sources.

6 stones out of 50 stones, or 12 per cent.; whereas the loss by steam is only 2 stones out of the 50. But besides this great difference in the loss itself, the state in which the remainder of the flesh is left, is worth 6d. a stone less after land travel; and when stock are sent to graze in that state, they require a month to take with the pasture, whereas the steam-carried will thrive again at the end of a fortnight. Besides all these disadvantages of land travel, the juices of the meat of fat stock never recover their natural state, while, by being carried by steam, they do. Were heavy and high-conditioned stock to be travelled by land, they would inevitably sink under the attempt, whilst by steam any degree of condition may be conveyed with comparative ease. The *time*, too, spent on a land journey is of consideration, when a more expeditious mode of travelling is in your option.

(1408.) With regard to the relative weights of offal and meat afforded by sheep, there are recorded instances of their proportions, and of a fat Southdown wether they were these, namely:—

Live weight 13 *st.* 10 *lb.*

Offal.	lb.	oz.	*Meat.*	lb.	oz.
Blood and entrails,	13	0	Fore-quarter,	29	0
Caul and loose fat,	21	4	Ditto,	28	12
Head and pluck,	8	12	Hind-quarter,	33	8
Pelt,	15	12	Ditto,	32	0
	58	12		113	4*

I may mention that the *carcass* consists of the entire useable meat of the body, which, when sawn down the middle of the back-bone, is divided into two *sides*, which, when again divided by the 5th rib, make the carcass to consist of 4 *quarters*. The remainder of the animal consists of offal, namely, of fat, entrails, head, and skin. In purchasing fat live-stock, the butcher is supposed to pay the market value of the carcass, bone and meat, to the farmer, reserving the offal to himself for his profit and risk. The relative proportions of mutton and offal have probably never been absolutely ascertained, as they must differ in different breeds of sheep; but there is little doubt that, in the Leicester breed, the meat bears a higher proportion to the offal than in any other breed. In the above case, the meat is about $\frac{2}{3}$ and offal $\frac{1}{3}$ of the whole weight, or more nearly, the meat is as $123\frac{1}{4}$: 182, and the offal as $58\frac{3}{4}$: 182. And in the same breed it has been said that the proportion of bone is as low as 1 oz. to 1 lb. flesh; but I much doubt this, because Mr Donovan found in a leg of mutton, which is the most fleshy part of the carcass in proportion to the bone in it, weighing $9\frac{1}{4}$ lb. 16 oz. of bone; another of 9 lb. 6 oz., 15 oz.; and a leg of small Scotch mutton of only 6 lb. weight, afforded $10\frac{1}{2}$ oz. of bone.

(1409.) There is a rule mentioned by Mr Ellman of Glynde, in Sussex, by which the age of mutton may be ascertained by certain marks on the carcass, and it is an infallible one. He says, "Observe the *colour* of the *breast-bone* when a

* Sussex Agricultural Report, p. 328.

sheep is dressed, that is, where the breast-bone is separated; which, in a lamb, or before it is 1 year old, will be quite red; from 1 to 2 years old, the upper and lower bone will be changing to white, and a small circle of white will appear round the edges of the other bones, and the middle part of the breast-bone will yet continue red; at 3 years old, a very small streak of red will be seen in the middle of the 4 middle bones, and the others will be white; and at 4 years, all the breast-bone will be of a white or gristly colour."*

(1410.) The experiments of Mr Donovan prove that meat of all kinds lose a considerable proportion of weight on being cooked. His results on mutton were:—The average loss on *boiling* legs of mutton is 10 per cent.; so that if the butchers' price were 6d. per lb., the boiled mutton would cost 7½d. The average loss *of roasting* legs of mutton is $27\frac{7}{10}$ per cent.; so that, at the butcher's price of 6d. per lb., the roasted mutton would cost 8¼d. per lb. The average loss of roasting shoulders of mutton is 28 per cent.; and were the butcher's price 5d. per lb., the roasted shoulder would cost $6\frac{9}{10}$d. per lb. The average loss, therefore, in boiling mutton is 10 per cent., and in roasting it $27\frac{85}{100}$ per cent. These results differ considerably from those obtained by Professor Wallace, who, in the case of *boiling* 100 lb. of mutton, detected a loss of 21½ per cent., instead of 10 per cent.; and in that of *roasting* 100 lb. the loss was 31½ instead of 28 per cent. These discrepancies might perhaps be easily explained, were we acquainted with every particular connected with both sets of experiments, such as the state of the meat before and after being cooked. In these respects, in his own experiments, Mr Donovan says, "I used meat of sufficient, but not unprofitable fatness, such as is preferred by families; the meat was in all cases a little rare at its centre, and the results were determined with the utmost care."†

(1411.) Good *ham* may be made of any part of a carcass of mutton, though the *leg* is preferred, and for this purpose it is cut in the English fashion. It should be rubbed all over with good Liverpool salt, and a little saltpetre, for 10 minutes, and then laid in a dish and covered with a cloth for 8 or 10 days. After that it should be rubbed again slightly for about 5 minutes, and then hung up in a *dry* place, say the roof of the kitchen, until used. Wether mutton is used for hams, because it is fat, and it may be cured any time from November to May; but tup mutton makes the largest and highest flavoured ham, provided it be cured in spring, because it is out of season in autumn.

(1412.) There is an economical way of using fat mutton well adapted for the labouring people of a farm. The only time Scotch farm-servants indulge in butcher-meat is when a sheep *falls*, as it is termed; that is, when it is killed before being affected with an unwholesome disease, and the mutton is sold at a reduced price. Shred down the suet small, removing any flesh or cellular membrane adhering to it; then mix amongst it intimately ½ oz. of salt and a teaspoonful of pepper to every pound of suet; put the mixture into an earthen jar, and tie up tightly with bladder. One table-spoonful of seasoned suet will, at any time, make good barley-broth or potato-soup for two persons. The lean of the mutton may be shred down small, and seasoned in a similar manner, and used when required; or it may be corned with salt, and used as a joint.

(1413.) Where Leicester sheep are bred, and the farmer kills his own mut-

* British Husbandry, vol. ii. p. 486.

† Donovan's Domestic Economy, vol. ii.

ton, suet will accumulate beyond what can be used for domestic purposes. As long as it is fresh it should be *rynded* or *rendered*, as it is termed, that is, prepared for preservation; because the fibrous and fleshy matter mixed with it soon promotes putrefaction. It should be cut in small pieces, removing only fleshy matter. It is then put in an earthen jar, which is placed within a pot containing warm water, at the side of the fire, merely to simmer, and not to boil. As every portion put in is melted, another succeeds, until the whole is melted; and the melted mass should be very frequently stirred. Suet melts at from 98° to 104° Fahr. After being fused a considerable time, the membranous matter comes to the top, and is taken off; and when obtained in quantity and squeezed, this scum constitutes the *cracklings* which are sometimes used for feeding dogs. The purified suet may then be poured through a cullender, into a dish containing a little water, upon which it consolidates into a cake; and the cakes are either sold to the candlemakers, or candles taken in exchange. "Many plans for purifying fats," says Ure, "have been proposed. One of the best is to mix 2 per cent. of strong sulphuric acid with a quantity of water, in which the tallow is heated for some time with much stirring; to allow the materials to cool, to take off the supernatant fat, and remelt it with abundance of hot water. More tallow will thus be obtained, and that considerably whiter and harder, than is usually procured by the melters." * Some people melt suet in a pot over the fire, where it is apt to be burnt; and some even fry it in a frying-pan, which may answer for culinary purposes, but cannot of course be disposed of to the candlemakers.

(1414.) Mutton-suet consists of about 77 parts of stearine and 23 of oleine in every 100 parts. The former is solid, the latter fluid. The specific gravity of suet is 0.936. When a piece of solid suet is broken, innumerable minute granules separate from the mass; and these, when examined by the microscope, exhibit definite forms, being polyhedral, bounded within the limits of a sphere, or oblong, of very firm consistence, and, when measured, give dimensions varying in length from $\frac{1}{400}$ to $\frac{1}{900}$, and in breadth from $\frac{1}{200}$ to $\frac{1}{300}$ part of an inch.† The constituent parts of suet, according to Chevreul, are carbon 78.996, hydrogen 11.700, and oxygen 9.304.‡

(1415.) Fat is very generally distributed in the animal frame. It is "abundant under the skin, in what is called the cellular membrane, round the kidneys, in the folds of the omentum, at the base of the heart, in the mediastinum, the mesenteric web, as well as upon the surface of the intestines, and among many of the muscles. It varies in consistence, colour, and smell, according to the animal from which it is obtained. Thus, it is generally fluid in the cetaceous tribes, soft and rank-flavoured in the carnivorous, solid and nearly scentless in the ruminants; usually white and copious in well-fed young animals, yellowish and more scanty in the old. Its consistence varies also according to the organ of its production, being firmer under the skin and in the neighbourhood of the kidneys than among the movable viscera. Fat forms $\frac{1}{20}$ of the weight of a healthy animal; but as taken out by the butcher it is not pure, for, being of a vesicular structure, it is always enclosed in membranes, mixed with blood, bloodvessels, lymphatics, &c." §

(1416.) Sheep is one of the most useful, and therefore one of the most va-

* Ure's Dictionary of the Arts, art. *Fat.*

† Raspail's Organic Chemistry, p. 238.

‡ Liebig's Animal Chemistry, p. 300.

§ Ure's Dictionary of the Arts, art. *Fat.*

luable, of our domestic animals; it not only supports our life by its nutritious flesh, but clothes our bodies with its comfortable wool. All writers on diet have agreed in describing mutton as the most valuable of the articles of human food. "Pork may be more stimulating, beef perhaps more nutritious, when the digestive powers are strong; but while there is in mutton sufficient nutriment, there is also that degree of consistency and readiness of assimilation which renders it most congenial to the human stomach, most easy of digestion, and most contributable to health. . . . . Of it, almost alone, can it be said, that it is our food in sickness as well as in health; its broth is the first thing that an invalid is permitted to taste, the first thing that he relishes, and is his natural preparation for a return to his common aliment."* In the same circumstances, it appears that fresh mutton, broiled or boiled, takes 3 hours to digest; fresh mutton, roasted, $3\frac{1}{4}$ hours; and mutton-suet boiled, $4\frac{1}{2}$ hours.†

(1417.) But the products of sheep are not merely useful to man, they also promote his luxuries. The skin of sheep is made into leather, and when so manufactured with the fleece on, makes comfortable mats for the doors of our rooms, and rugs for our carriages. For this purpose, the best skins are selected, and such as are covered with the longest and most beautiful fleece. Tanned sheep-skin is used in coarse bookbinding. White sheep-skin, which is not tanned, but so manufactured by a peculiar process, is used as aprons by many classes of artizans, and in agriculture, as gloves in harvest; and when cut into strips, as twine for sewing together the leathern coverings and stuffings of horse-collars. Morocco leather is made of sheep-skins as well as of goats, and the bright-red colour is given to it by cochineal. Russia leather is also made of sheep-skins, the peculiar odour of which repels insects from its vicinity, and resists the mould arising from damp, the odour being imparted to it in currying, by the empyreumatic oil of the bark of the birch tree. Besides soft leather, sheep-skins are made into a fine, flexible, thin substance, known by the name of parchment; and though the skins of all animals might be converted into writing materials, only those of the sheep and she-goat are used for parchment. The finer quality of the substance called vellum is made of the skins of kids and dead-born lambs, and for the manufacture of which the town of Strasburgh has long been celebrated.

(1418.) Mutton-suet is used in the manufacture of common *candles*, with a proportion of ox-tallow. Minced suet, subjected to the action of high-pressure steam in a digester at 250° or 260° Fahr., becomes so hard as to be sonorous when struck, whiter, and capable, when made into candles, of giving very superior light. Stearic candles, the late invention of the celebrated Guy-Lussac, are manufactured solely from mutton-suet.

(1419.) Besides the fat, the intestines of sheep are manufactured into various articles of luxury and utility, which pass under the absurd name of catgut. "All the intestines of sheep," says Mr Youatt, "are composed of 4 coats or layers, as in the horse and cattle. The outer or *peritoneal* one is formed of that membrane by which every portion of the belly and its contents is invested, and confined in its natural and proper situation. It is highly smooth and polished, and it secretes a watery fluid which contributes to preserve that smoothness, and to prevent all friction and concussion during the different motions of the animals.

* Edinburgh Encyclopædia, art. *Aliments*, as quoted by Youatt on Sheep, p. 11.

† Combe on Digestion and Dietetics, p. 135–6.

The second is the *muscular* coat, by means of which the contents of the intestines are gradually propelled from the stomach to the rectum, thence to be expelled when all the useful nutriment is extracted. The muscles, as in all the other intestines, are disposed in two layers, the fibres of the outer coat taking a longitudinal direction, and the inner layer being circular; an arrangement different from that of the muscles of the œsophagus, and in both beautifully adapted to the respective functions of the tube. The submucous coat comes next. It is composed of numerous glands, surrounded by cellular tissue, and by which the inner coat is lubricated, so that there may be no obstruction to the passage of the food. The *mucous* coat is the soft villous one lining the intestinal cavity. In its healthy state, it is always covered with mucus; and when the glands beneath are stimulated—as under the action of physic—the quantity of mucus is increased; it becomes of a more watery character; the contents of the intestines are softened and dissolved by it; and by means of the increased action of the muscular coat, which, as well as the mucous one, feels the stimulus of the physic, the fæces are hurried on more rapidly and discharged." * In the manufacture of some sorts of cords from the intestines of sheep, the outer peritoneal coat is taken off and manufactured into a thread to sew intestines, and make the cords of rackets and battledores. Future washings cleanse the guts, which are then twisted into different-sized cords for various purposes. Some of the best known of those purposes are whip-cords, hatters' cords for bow-strings, clockmakers' cord, bands for spinning-wheels (which have now almost become obsolete), and fiddle and harp strings. Of this last class of cords—the source of one of our highest pleasures—it has long been subject of regret, that those manufactured in England should be so inferior in goodness and strength to those of Italy; and the reason assigned is, that the sheep of Italy are both smaller and leaner than those of this country. The difficulty lies, it seems, in making the treble strings from the fine peritoneal coat, their chief fault being weakness, whence the smaller ones are hardly able to bear the stretch required for the higher notes in concert-pitch; maintaining, at the same time, in their form and construction, that tenuity or smallness of diameter which is required to produce a brilliant and clear tone.† However contemptible this subject may appear in the estimation of some, it is worth attending to by those interested in enhancing the profits of our native products, and more especially when it is considered that harp-strings sell as high as from 6d. to 2s. a-piece.

(1420.) While adverting to the uses of the skin of the sheep, it may be useful to give an idea of its physical structure, a knowledge of which being requisite for an acquaintance of the rationale of its diseases. "It is composed of 3 textures. Externally is the *cuticle* or *scarf-skin*, which is thin, tough, devoid of feeling, and pierced by innumerable minute holes, through which pass the fibres of the wool and the insensible perspiration. It seems to be of a scaly texture; but this is not so evident in the sheep as in many other animals, on account of a peculiar substance, the *yolk*, which is placed on it to nourish and protect the roots of the wool. It is, however, plainly enough to be seen in the scab and other cutaneous eruptions to which the sheep is liable. Below this is the *rete mucosum*, a soft structure; its fibres having scarcely more consistence than mucilage, and being with great difficulty separated from the skin beneath. This seems to be placed

* Youatt on Sheep, p. 462.

† Ure's Dictionary of the Arts, art. *Catgut*; also *Leather*, *Parchment*.

as a defence to the termination of the bloodvessels and nerves of the skin, and these are in a manner enveloped and covered by it. The colour of the skin, and probably that of the hair or wool also, is determined by the *rete mucosum*, or at least the hair and wool are of the same colour as this substance. Beneath is the *cutis* or *true skin*, composed of innumerable minute fibres crossing each other in every direction; highly elastic, in order to fit closely to the parts beneath, and to yield to the various motions of the body; and dense and firm in its structure, that it may resist external injury. Bloodvessels and nerves, countless in number, pierce it, and appear on its surface under the form of *papillæ*, or minute eminences, while, through thousands of orifices, the exhalant absorbents pour out the superfluous or redundant fluid. The true skin is composed principally or almost entirely of gelatine, so that, although it may be dissolved by long continued boiling, it is insoluble in water at the common temperature. This organization seems to have been given to it, not only for the sake of its preservation, while on the living animal, but that it may become afterwards useful to man." It would appear that there are circumstances which materially limit the action of the power of excretion and absorption in the skin of the sheep. It is surrounded by a peculiar secretion, adhesive and impenetrable to moisture, the yolk, destined chiefly to preserve the wool in a soft, pliable, and healthy state. On this account there can be little perspiration going forward from the skin, and hence few diseases are referable to change in that excretion. Also, there is little radiation of animal heat, both on account of the interposition of the yolk, and of the non-conducting power of the wool. The caloric disengaged from a sheep is only $\frac{1}{7}$ part of that from man, though the weight of the animal is $\frac{1}{3}$ of that of man, that is, only half the animal heat radiates from a sheep, from a given surface, that does from a man. This it is which enables the ewe and its lamb to endure the colds of spring without detriment; and also, when sheep are crowded together in an open fold, no unnatural or dangerous state of heat is thereby produced.*

---

34. OF REARING AND FEEDING CATTLE ON TURNIPS IN WINTER.

> " The cattle from th' untasted fields return,
> And ask, with meaning low, their wonted stalls,
> Or ruminate in the contiguous shade."
>
> THOMSON.

(1421.) THE first thing to be done with the courts in the steading, before being taken possession of by the cattle, is to have them *littered plentifully with straw*. The first littering should be abundant, as a thin layer of straw upon the bare ground makes an uncomfortable bed; where-

* Youatt on Sheep, p. 52 and 535.

as a thick one is not only comfortable in itself, but the lower part of it acts as a drainer to the heap of manure above it. There is more of comfort for cattle involved in this little affair than most farmers seem to be aware of; for it is obvious, that the first layer of litter, when thin, will soon get trampled down, and in rainy weather soon become poached, that is, saturated with wet and pierced with holes by the cattle's feet, so that any *small* quantity of litter that is afterwards laid upon it will but absorb the moisture below it, and never afford a *dry* lair to the cattle. On the other hand, when the first layer is thick, it is not poached even in wet weather, because it is with difficulty pierced through by feet, and it instantly drains the moisture that falls upon it, and of course keeps the bedding comparatively dry.

(1422.) There is, however, sometimes a difficulty of obtaining sufficient straw at this season from various causes, amongst which may be mentioned a dislike in farmers to thrash a stack or two of the new crop at so early a period, even when there is no old straw or old stack of corn to thrash; but however recently formed the stacks may be, and inconvenient to thrash their produce at the time, it should be done rather than stint the cattle of bedding; and should bad weather immediately set in, an event not unlikely to happen, the cattle may be so chilled in their ill-littered quarters, as not entirely to recover from it during the winter; and hence may arise a serious reduction of profit.

(1423.) It may happen, on the other hand, with plenty of old stacks, there may be want of water to drive the thrashing-machine, and this is no uncommon predicament at the commencement of winter on many farms which depend upon surface-water for their supply; and a windmill is in no better plight in want of wind. Where such contingencies *may* happen, a sufficient quantity of litter should be provided for in good time, and there are various ways of doing this. Those who still use the flail may employ it at any season; and those having horse thrashing-mills are equally independent. Access to bog-land gives the command of making coarse herbage into hay during summer; but in regard to the use of other products of bog-land for litter, precaution is requisite, for the turfy matter on the top on being used as a bottoming for courts, with the view of absorbing their moisture, will inevitably become as a sponge of water after the first fall of rain, and the cattle will soon render the whole bedding a poached mass. I once tried the experiment under the most favourable circumstances of getting the turf well dried, and yet could not get rid of the inconvenience of poaching until the courts were entirely cleared of their contents. Those who are annoyed with ferns in their pastures should cut them down and won them for litter, and a most excellent

foundation they make for straw. Those who can cut grass, or gather dry leaves in woods, should do so in summer, or immediately after harvest for a day or two with the harvest people. By attending to one or all of these provident measures, a comfortable bed may be provided for cattle at the commencement of the season, under the most unfavourable circumstances in regard to a command of straw.

(1424.) Suppose, then, that all the courts and hammels are plentifully littered for the reception of the cattle, the next step is to arrange the different classes of cattle in their respective places. The different classes of cattle are cows, calves of the year, 1-year-olds, 2-year-olds, bulls, heifers in calf, and any extra cattle.

(1425.) *Cows* occupy the byre Q, fig. 3, Plate III. (42.) Each should always occupy the stall she has been accustomed to, and all will then go out and come into their stalls without interfering with one another. They thus learn to become very quiet in the stall, both to the cattle-man who feeds them, and the dairy-maid who milks them. Each stall should have a manger *c*, fig. 10 (47.), elevated 20 inches above the floor, lined with wood or stone, and having an edging of plank 8 inches in depth, to keep in the food. The usual plan is to place the mangers of byres on a level with the floor, down to which the cow has to stretch her neck to get to the turnip, or other food, and in doing this she is obliged to support herself almost wholly on one leg. This awkwardness of position is itself a certain proof that the animal is ill at ease while eating. There should be as much room behind the manger to the gutter as to allow the cow to lie at ease, whatever be her size, like a horse in a stall with a low hay-rack. Each stall should have a travis-board to separate it from the next (149.). Some people are great advocates for double stalls, both in byres and stables, to hold a pair of animals each. In a byre that plan is objectionable for several reasons; a cow is a capricious creature, and not always friendly to her neighbour, and one of them, in that case, must be bound to the stake on the same side as she is milked from; to avoid which inconvenience to the dairy-maid, the cow must either be put aside nearer her neighbour in the same stall, which may prove unpleasant to both parties, or her neighbour in the adjoining stall be put aside nearer *her* neighbour, which may prove equally inconvenient. Neither is it a matter of indifference to the cow from which side she is milked, for many will not let down their milk if the milk-maid sits down to the unaccustomed side. The safest plan, therefore, in every respect, is for each cow to have her own stall. The floor of the stall should be causewayed only as far as shewn at *m*, fig. 10, and the remainder at *f* should be of beaten earth, and this plan is intended to save the fore-knees of cows from in-

jury. *Cattle* lie down and rise up by resting on the fore-knees, and when they have to do so on a hard pavement, injury will likely arise to the knees if the pavement is not always covered with litter. I remember seeing a valuable short-horn cow, in Ireland, get injured in the knees from this cause; they swelled so much and continued so long in a tender state that she would not lie down at all; and all the while her owner was not aware of the cause until I suggested it. On the removal of the pavement, and proper treatment of the parts affected, they recovered. Cows are bound to the stake *h*, fig. 10, either by seal *c d*, fig. 11, or baikie, *e k g*, fig. 12, and either *secures* the animal sufficiently. The seal is made entirely of iron-chain, and slides up and down the inclined stake *h* by means of the iron ring *d*; the baikie is made partly of wood *e*, and partly of rope *k* and *g*. Of the two modes of ligature I prefer the seal, because its construction permits the animal turning its head so much round as to be able to lick herself as far as the loin, whereas the baikie only admits of a constrained up and down motion along a perpendicular stake (48.); and, besides, it is an impracticable mode of binding in connection with the use of a manger, because it prevents the animal stepping back to avoid it.

(1426.) *Calves of the year* should occupy court K, fig. 3, Plate III. (62.) In such receptacles they are put together male and female, strong and weak, but having plenty of trough room around two of the walls, they can all be amply provided with food at the same time, without the danger of the stronger buffetting about the weaker. The openings into the shed in which they take up their abode at night is at D, and in the centre of the court stands the straw-rack *o*, formed like fig. 19 where straw is scarce, as on gravelly soils, or like figs. 20 and 21 where it is plenty. The troughs for the turnips are fitted up as in fig. 18, which is there represented as a short one, to shew the finishings of the ends, but which, of course, may be extended to any length, as may be seen by *z* in K, fig. 4, Plate IV. There is a water-trough *w* in the same court, it being essential for young stock to have water at will, and especially when they do not get as many turnips as they can eat. When they do, cattle do not feel the want of water, the juice of the turnip supplying them with sufficient liquid. In the same Plate IV. may be seen the shed D, under the granary, connected with the court K, having a straw-rack *h'* fitted up at one end. The turnip-store for this court is at *g*; and *x* is the mouth of the liquid-manure drain, to carry off any superfluous water. In the calves of the year occupying this court K, where there is a good deal of traffic in going to and from the corn-barn C, the young creatures will become familiarized with people, and have a chance of getting pickings of corn from the barn.

(1427.) The court I is fitted up precisely with the same conveniences of feeding-troughs *z*, water-trough *w*, straw-racks *h* and *o*, and turnip-store *i*, as the other court for the 1-year olds. It will be observed that the shed D, in both courts, has two entrances, which is the usual plan; but, in my opinion, the comfort of the cattle is more secured with only one entrance, inasmuch as all draught is prevented; and although the object of two entrances is a laudable one in affording a means of escape to a beast that may be ill-used by the rest, that advantage to one is dearly bought at the sacrifice of comfort to the others, and after all it is doubtful whether the contingency can be avoided in this way.

(1428.) As I have said before (62.), I prefer hammels to large courts, for young beasts; because the heifers could be separated from the steers, and each of the classes subdivided to suit colour, strength, age, temper, or any other point in which a few agree, and differ from the rest; and it is surprising how much better the same beasts look when assorted. In a large court, all are put together, and, if there be plenty of room for every one to do as it likes, no harm may accrue; but where too many are crowded together, which is almost always the case on farms where winterings are bought in, some will be knocked about and kept back from their meat, and obliged to eat it at untimeous hours; and in either plight will be stinted in their growth and condition. Only one beast so used makes a serious drawback on the value of the lot, for it must be drafted from the rest and sold separately, at a reduced price, to the vexation of the owner, when too late to retrieve the loss. Now, no such occurrence can take place in hammels, where every difference in character, age, and strength of animals, can be nicely assorted; and this is the more requisite in beasts that have been bought in to be fed, than those brought up together at home.

(1429.) The *2-year olds, intended to be fattened for the butcher*, occupy the hammels M, where are inner sheds at M, feeding-troughs *z*, liquid-manure drains *x*, in the courts, and where fodder is supplied in the inside of the sheds, in racks, in three of the corners, and the turnip-stores of which are at *e* and *f*. The sheds being 14 feet wide and 18 feet long, and the courts 30 feet long by 18 feet in width, each hammel will accommodate 4 steers, not merely at the beginning of the feeding season, but at its end, when they shall have attained the weight of at least 70 stones each imperial.

(1430.) Occasionally the cow stock requires to be renewed, one or two at a time, by *young heifers;* and as these, when in calf, should not of course be fattened, they should not be put in the hammels of the feeding-stock of their own age, namely, the 2-year olds, but have hammels

to themselves at N, which are fitted up in precisely the same manner as at M, with feeding-troughs *z*, straw-racks in the corner of the sheds, liquid-manure drains *x*, and turnip-stores *p* and *q*. Their size, inside the shed, is 17 feet long by 14 feet wide, and the court 20 feet long by 17 feet wide, so that each can accommodate 3 heifers in calf. The *old cows* which these heifers are intended to supersede, have to be fattened, and they can be accommodated with one of the hammels at N.

(1431.) The *servants' cows* are accommodated in the byre Y, fitted up in the same manner as the other byre Q, having an outer court *v*, water-trough *w*, liquid-manure drain *x*, and turnip-store *h*.

(1432.) When *oxen are fattened in byres* instead of hammels, they are accommodated in the same manner as the cows are in either Q or Y; but instead of each having a stall, they are usually bound up in pairs in double stalls, with a partition in the turnip-trough, placed on the ground, and a travis between every pair. Stalls of this construction are often as narrow as 7 feet, but 8 feet is the more common width. I have already condemned the crowded state in which oxen, fed in byres, are usually placed (49.), and shall not again advert to the subject here. When cattle are bound to the stake for the first time, for the season, they are apt to be restless until reconciled to their confinement, which they will be ere long, if provided with plenty of food.

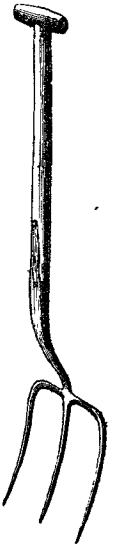
(1433.) Bulls occupy the hammels X, which are fitted up with feeding-troughs *z*, water-troughs *w*, liquid-manure drains *x*, and racks in the corners of the sheds X. More than one bull-calf may be put together; but more than one bull that have served cows are never intrusted together.

(1434.) Having thus accommodated all the cattle, according to their kinds and ages, in their respective places in the steading, for the winter, let us now attend to the treatment which each class should daily receive during their confinement.

(1435.) And to begin with the *cows*. The first piece of work connected with the treatment of cows in winter, is to milk them at daybreak, which cannot be at a very early hour at this season. On farms on which cows are bred, they are heavy in calf in winter; so most of them will be dry, and those still yielding milk, being the latest to calve, will give but a scanty supply. It is, therefore, not as *milch*-cows they are treated at this season. After milking is finished by the dairy-maid the usual practice is to give the cows, though heavy in calf, a feed of cold turnips, on an empty stomach, which I have always considered an injudicious practice; and its injudiciousness is evinced by the fact of the fœtus shewing unequivocal symptoms of its existence in the womb, in the

same manner as after a drink of cold water in the morning. I would, therefore, give them a mouthful of fresh oat-straw, to prepare the stomach for the turnips. While amusing themselves with this fodder, the cattle-man, whose duty it is to take charge of all the cattle in the steading in winter, cleans out the byre of its litter and dung with the graip, fig. 257, and shovel (fig. 149), and wheel-barrow, and spreads it equally over the court, sweeping the gutter and causeway clean with a birch or broom-besom. Having shut the byre-door and left the half-door into the court open for fresh air, the cattle-man leaves the cows until he has supplied the fattening and young beasts with turnips, which having done, he returns to the cow-byre, bringing litter-straw with him, and gives them their allowance of turnips for the first meal. Cows in calf never get as many turnips as they can eat, the object being not to fatten, but support them in a fair condition for calving; for were they fed fat, they would run the risk of life at calving through inflammation, and the calves would be small. It is not easy to specify the number or weight of turnips that should be given to cows; but I conceive that $\frac{1}{3}$ of what a feeding ox would consume will suffice.

Fig. 257.



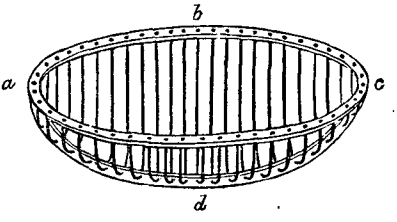
THE GRAIP.

(1436.) There are three ways of supplying cows with turnips, either through the openings of the wall at their heads, as at *o*, fig. 10, and through the door, fig. 9, from the store in the shed *s*, into the trough *c*; or with basketfuls, carried by the stall; or with barrow-loads, wheeled along a passage at their head, as described in (45), and emptied into the same troughs *c* from the same store *s*, as seen in plan at *m*, fig. 4, Plate IV., by the back door into the byre.

(1437.) With the willow-basket or *skull*, is the most common way of serving cows or cattle in byres with turnips. It is about 2 feet in diameter, with holes wrought into each side, under the rim, for handles, and costs about 1s. 6d.; but they are very apt to become rotten or broken after the natural sap is dried out of the willows, which is generally in a few months' time, and then they become very brittle. In short, a skull seldom lasts more than a year or two; and as a number of them are required about a steading where a variety of beasts are fed on turnips, their cost, though individually trifling, becomes in the aggregate so considerable, as to make its avoidance desirable. A basket of wire or small iron rods has been substituted in some places. A wire-basket is represented by fig. 258, where the rim *a b c*, which forms its mouth, is a flat slip of iron about $\frac{3}{4}$ of an inch in breadth, and

the keel or bottom *a d c* is of the same dimensions and materials. Holes are punched through them, at about 3 inches apart from each other. The small iron rods are inserted through them, receiving a bend to suit the form of the basket, and the ends of those attached to the rim *a b c* are shouldered below, and made fast with a counter-sink rivet above. The spaces left at the ends of the keel, under the rim, at *a* and *c*, form the handles. The cost is about 2s. 6d. each, and with due care —such as the replacement of a rod now and then, when broken,—will last from 5 to 10 years. Were the keel made straight at *d*, the basket would stand steadier to be filled.*

Fig. 258.



THE WIRE TURNIP-BASKET.

(1438.) Before the turnips are put into the troughs, the remains of the fodder given in the morning should be strewed down for litter, and the troughs cleaned out. The turnips should always be put into the troughs in a regular order, beginning at the same end of the byre, and finishing at the other; and after the turnips have been given, the cows should be permitted to eat them in quiet, for nothing irritates animals more than to be handled and worked about when feeding. The turnips consumed, and the stalls comfortably littered with straw, the cows will lie down and chew the cud until midday, when they should be turned into the court to enjoy the fresh air, lick themselves and one another, drink water from the trough, and bask in the sun. They should go out a while every day, in all weathers, until they calve, except perhaps in a very cold wet day. One hour may be long enough at a time. In loosening cows from their stalls, a plan requires to be pursued to prevent confusion. In the first place, every cow, in the beginning of the season, should be put in the stall she has occupied since she first became an inmate of the byre; and she will always go to *it*, and no other, avoiding the least collision with the rest. In loosening them from the stalls, they should be so one by one, always beginning at the same end of the byre, and finishing at the other, and not indiscriminately. This will prevent collision on the floor and jamming in the doorway on going out,—accidents injurious to animals with young. After their return, they should also be bound in the same regular order from one end of the byre to the other, and this will prevent any one being forgotten to be bound; and to

* Quarterly Journal of Agriculture vol. xi p. 112.

remove every temptation from even a greedy cow running up into another one's stall for the sake of snatching a little of her food, no food should be lying in the troughs when they return to their stalls; and no food that they like,—such as turnips, mangel-würzel, and the like,—should be given them immediately on returning to the byre, because the expectation of receiving it will not only render them impatient to leave the court, but make them restless in the stall until they receive it. This plan, contrary to usual practice, will, it is obvious, suppress all anxiety, and thereby prevent violation of discipline, and, of course, necessity for correction. When subjected to this regular form of discipline, they will soon obey it, and make no confusion, but conduct themselves peaceably. On their return into the byre, let a little fodder be given; and after a lapse of time, say at 3 P.M., give them their evening meal of turnips, after which they should be littered for the night.

(1439.) The treatment of *oxen* in a byre is different from that of cows; they get as many turnips as they can eat, and are not permitted to leave their stalls until sold off fat. As it is not usual for oxen to be fed in byres and hammels on the same farm, what I have to say in regard to feeding in the byre should be considered in lieu of the plan of what I shall have to say on feeding them in hammels. After the cow-byre doors have been opened, and the stalls cleared into the gutter of any dung that might annoy the dairymaid, the cattle-man goes to the feeding-byre, and, first removing any fodder that may have been left from the previous night, and any refuse of turnips or other dirt, from the troughs, gives the cattle a feed of turnips at once. The quantity to be given at this time should be $\frac{1}{3}$ of what they can eat during the day; for they should be fed 3 times a day—in the morning, at noon, and at sunset; and in distributing the food, the same regularity should be observed as in the case of the cows, that is, the same ox should always be the first supplied, and the same ox the last to receive his portion. When cattle find their food given them in regular order, they never become impatient for their turn. It is a good plan to begin serving at the farthest end of the byre, because then the cattle-man has no occasion to pass and disturb those which have been served; and in the case of what is called a *double-headed* byre, in which cattle stand on both sides, tail to tail, both sides should be served simultaneously by alternate beasts, thus still leaving those which have been served undisturbed. With the half-door left open for the admission of fresh air, and the expulsion of heated air through the ventilators (fig. 8.), the cattle-man leaves them to enjoy their meal in quietness.

(1440.) Much has been said on the expediency of wisping and currying cows and fattening beasts in the byre; and no doubt many satisfactory

reasons could be urged in favour of the practice, when they are entirely confined. But, as it occurs to me, animals, that are allowed to be at liberty at one part of the day, do not require—or at least to a much smaller degree—any artificial dressing, inasmuch as they can dress their own skin, when at liberty, much better than any cattle-man. Nevertheless, where cattle are constantly confined in the byre, as is the case of all beasts fattened in a byre, it seems indispensable for their good health to rub their skin every day by some process; and I believe there are no better instruments for the purpose than a simple curry-comb and a wisp of straw. In performing this operation, however, it should only be done when the cattle are not at food; and you should see to this, for there is a strong propensity in people, who have charge of animals, to dress and fondle with them when at food; from no desire, I am sure, of tormenting them, but the contrary. Still it is a habit which has a tendency to irritate all animals unnecessarily, and should be prevented; for any one may soon satisfy himself, from observation, that an animal is never more jealous of being approached than when eating his food,—as witness the grumble from a dog or the scowl from a horse.

(1441.) Whenever the cattle have eaten their turnips the byre should be completely cleared of the dung and dirty litter with the graip, shovel, besom, and barrow belonging to the byre. A fresh foddering and a fresh littering being given, they should be left to themselves to rest and chew the cud, until the next time of feeding, which should be about mid-day, when another $\frac{1}{3}$ of turnips is given to each ox; after finishing which more fodder should be supplied, and what dung may prove annoying, drawn into the gutter. In the afternoon, before day-light goes, the dung should again be cleared out, and the last supply of turnips for the day, another $\frac{1}{3}$, given to each ox; and before leaving them for the night, and after the turnips are eaten up, a fresh foddering should be given, and the litter shaken up and augmented where requisite. After eating a little fodder the cattle lie down and rest until visited at night.

(1442.) Where cattle are fattened in *hammels*, a somewhat different procedure is adopted. While the dairy-maid is milking the cows in the byre, the cattle-man cleans the troughs of the hammels with an old shovel, and gives the first supply of turnips for the day to the cattle; and in doing this he should adopt the same rule as to regularity as with the cows in the byre, always beginning with the same hammel.

(1443.) It is now well understood that sliced turnips afford great facilities to cattle in filling their stomachs with food with the least trouble; and the instruments used for this purpose are much simpler than those which have been described for sheep in (1357.) and (1364.). Not an

uncommon instrument for the purpose is an old sharp spade, with which turnips are broken into as many pieces as desired; but it is objectionable, in as far as it breaks them in unequal pieces, the round turnips rolling away from its strokes, and it scatters the hard ones in splinters. Much better instruments will be found in the two hand turnip choppers described below, figs. 263 and 264. A single perpendicular stroke with either of these instruments cuts a turnip into a certain number of pieces; but in using fig. 263 a little dexterity is required to save its cutting edges from being injured against the bottom of the trough. The dexterity consists in first getting a hold of the turnip with the instrument by a gentle tap, and then lifting up the turnip, striking it against the bottom of the trough with a smart stroke, when it will fall into pieces before the knives touch the trough; but the constant exercise of dexterity is scarcely to be looked for in an ordinary cattle-man, and, therefore, fig. 264 may be pronounced the more useful instrument of the two, for the studs serve to guard the cutting surface from injury. But where a cattle-man has charge of a large number of cattle receiving cut turnips, a more expeditious process of slicing them is required, and this will be obtained by the use of the lever turnip-slicer, described below in fig. 259. This machine is placed beside the turnip store, where it slices the turnips into the skull placed under it, and, being light, can easily be carried from store to store, unless where the distance is great, when another machine should be provided. It will be observed that all these implements cut turnips into large pieces, which are sufficiently small for cattle, sheep requiring theirs cut into long narrow slips, to suit the form of their mouth.

(1444.) Cattle naturally feeling more appetised in the morning than during the day, their morning meal should be large, and while employed at it the cattle-man should furnish their racks with fresh oat-straw, to which they will repair from the turnips, and lie down in the open court or within the shed, according to the state of the weather, and chew their cud with composure. At mid-day their troughs should again be replenished with turnips, and again before day-light is gone. The quantity given at the evening meal partly depends upon the state of the moon; for cattle, as well as sheep, will always feed during the night in moonlight, a habit which I have frequently observed in both animals; and from this fact I conclude, that if light were placed beside cattle in the byre, they would also feed during the long winter nights, and, of course, fatten quicker.* The last foddering of straw is given after the evening

* That highly prized bird in France, the ortolan, feeds at dawn, and when confined for the purpose of being fattened, an artificial dawn is produced every three hours during the night by artificial light, when it eats its food, and thereby becomes much sooner fat.

meal of turnips; and, during the day, whenever the shed or court requires litter, the refuse straw of the foddering may be spread abroad, and in rainy weather it should be brought direct from the straw-barn.

(1445.) The younger cattle in the courts next receive their turnips, and of these the calves should have the precedence, as they take longer time to finish their meal than their older compeers. They occupying the court K, fig. 4, Plate IV., the turnips are wheeled from the store *g* to the troughs, and there broken with one of the hand turnip-choppers, fig. 263 or 264, or sliced in the store with the lever turnip-slicer, fig. 259. Their fodder is put both in the open straw-rack *o* and that under the shed at *h'*, and their litter strewed after the young beasts in the other large court have been served with turnips.

(1446.) Immediately after the calves, the year-olds in the court I are served with turnips, fodder, and litter, in the same order. All young beasts should get as many turnips as they can eat; but should the crop prove insufficient for this, let the calves have their full share, and the year-olds rather put on short allowance; but in a case of this kind occurring, the most prudent plan, perhaps, would be to purchase oil-cake for the fattening beasts, to be given along with some turnips, and let all the young beasts have their full share of turnips. To insure them still farther with this, the cows might also have oil-cake.

(1447.) The young heifers in the hammels N, and the bulls in the hammels X, next receive their turnips, and as neither of them get as many as they can eat, their proportion is divided into two small meals, one served after all the rest in the morning, and the other before the rest in the evening. Both these classes depending much upon fodder for food, it should be of the sweetest and freshest straw, and supplied at least 3 times a-day, morning, noon, and evening; and having water at command, and liberty to move about, they will maintain a fair condition. The heifers are supplied from their own turnip stores *p* or *q*, and the bulls from that belonging to the servants' cow-byre *h*.

(1448.) With regard to the supply of turnips to the servants' cows, much depends on the terms of the agreement made with the servants. Where a specified number of cart-loads are given, the servant may choose to give them to his cow during the earlier part of the winter or not, because, when she is dry, it is not usual to give her turnips; but if in milk, the servants family give what they choose from their own store. On the other hand, if the farmer has agreed to treat his servants' cows in the same manner as his own, then the cattle-man takes charge of them in the manner I have already described (1435.).

(1449.) From the beginning of the season until the end of the year,

white turnips alone are used, after which, to the end of the winter season, the yellows are brought into requisition, or Swedes where these are not cultivated. When turnips are brought from the field in a very dirty state, which will inevitably be the case in wet weather from clayey soil, they ought to be washed in tubs of water, and when they are so as long as the earth is fresh, they will be the more easily cleansed; and this is not so troublesome and expensive a business as may at first sight appear. A large tub of water, placed at a store when about to be filled with turnips, a field-worker, taking a small fork, picks up a turnip with it, and dashing it about in the water for an instant, pulls it off against the edge of the store or barrow; and in this way cleanses a great number in a short time, much faster than the cattle-man can wheel them away and serve and break them to the beasts. A friend of mine used a very curious mode to wash turnips. Whenever any of the fields of his farm, along which was the lead that conducted the water from the dam to the thrashing-mill, were in turnips, he filled the lead pretty full of water, by keeping down the sluice at the mill. He then topped and tailed the turnips in the field, and emptied them into the lead, from a cart when the distance to the turnips was considerable, and from a hand-barrow, carried by field-workers, when they were near. The sluice at the mill was then opened a little, and the gentle current thereby created in the water floated the turnips to the steading, where they were taken out and carried to the stores in barrows. When the turnips were very dirty, they were washed in the lead by a person pushing them about with a pole. That some provision for cleaning turnips is sometimes necessary, is obvious to me, for I have seen very fine cattle getting turnips to eat, in such a state, that the dirt actually bedaubed them to the very eyes, the tops being left on to make the matter worse. Surely no one will say that filth, in any shape, is beneficial to cattle; not that they dislike to lick earth, but then they do so only when they feel they require it to rectify acidity in the stomach.

(1450.) When turnips have not been stored, and are brought from the field as required, it is highly probable that they will be in a frozen state at times, when, even if broken by the instruments in use, they will be masticated by cattle with difficulty, besides the danger they run of being chilled by them; for cattle always have a staring coat after eating frozen turnips. This being the case, means should be used to thaw them, and the most available is to put them in tubs of cold water for some hours before being given to the cattle. Such expedients, to avoid greater evils, of course always incur expense, and it will be much greater than the comparatively trifling one of storing the same quantity of turnips at

the proper season, which, when done, every such petty source of vexation will be removed.

(1451.) It is supposed that a fattening ox, which will attain 70 stones imperial at the end of the season, consumes on an average, during the season, a double horse load of turnips per week, and, as carts are usually loaded in field work in winter, their weight may be estimated at about 12 cwt.; so each ox will consume about $1\frac{3}{4}$ cwt. or 14 stones a day, or $4\frac{2}{3}$ stones of each of 3 meals, and about 16 tons during the season of 26 weeks. The calves may consume $\frac{1}{2}$ or 7 stones, and the 2-year-olds $\frac{3}{4}$, or $10\frac{1}{2}$ stones a day. These comparative quantities are given from no authenticated data, for I suppose that no comparative trials with different ages of cattle have ever been made, but only from what I imagine to be near the truth; and some such estimate, at the beginning of the season, is useful to be made, that you may know whether your turnips will answer the stock. It has been correctly ascertained, however, by Mr Stephenson, Whitelaw, East Lothian, in a careful experiment of 17 weeks, that an ox, yielding under 30 stones of beef, consumes 1 cwt., or 8 stones every day;* and if cattle consume food somewhat in proportion to their live weight, in similar circumstances, as is believed, the above ratios may be pretty correct. And yet Mr Boswell of Kingcausie's four 2-year-olds, fed entirely on turnips, and which increased in live weight, in four months, from 40 to 45 cwt., only consumed a little more than 27 tons of yellow bullock turnips, or $8\frac{1}{2}$ stones each a-day.† So that Mr Boswell's cattle, of from 45 to 50 stones each, consumed only a very few more turnips than Mr Stephenson's, of 28 stones each. Such discrepancies shew how little we can yet anticipate when we undertake to fatten cattle. But there is this that may be said in explanation of this difference, which is, however, merely conjectural, that Mr Stephenson's lightest lot experimented on may have been West Highlanders, Mr Boswell's Aberdeenshires, and my supposition is made in reference to well-bred short-horns. It will be observed, that cows receiving $\frac{1}{3}$ of oxen, namely, $4\frac{2}{3}$ stones a-day, each skulful will contain rather more than 32 lb.

(1452.) The most personally laborious part of the duty of a cattle-man in winter is *carrying straw in large bundles on his back to every part of the steading*. A convenient means of carrying it is with a soft rope about the thickness of a finger, and 3 yards in length, furnished at one end with an iron ring through which the other end slips easily

* Prize Essays of the Highland and Agricultural Society, vol. xii. p. 64.

† Ibid., vol. xi. p. 462-3.

along until it is tight enough to retain the bundle, when a simple loop-knot keeps good what it has got. Provided with 3 or 4 such ropes, he can bundle the straw at his leisure in the barn, and have them ready to lift when required. The iron ring permits the rope to free itself readily from the straw when the bundle is loosened.

(1453.) The *dress* of a cattle-man is worth attending to, in regard to its appropriateness for his business. Having so much straw to carry on his back, a bonnet or low-crowned hat is most convenient for him; but what is of more importance, when he has charge of a bull, is to have the colour of his clothes of a sombre hue, free of all gaudy or strongly-contrasted colours, especially *red*, because that colour from some cause is peculiarly offensive to bulls. It is with red cloth that the bulls in Spain are irritated at their celebrated bull-baits. Instances are in remembrance of bulls turning upon their keepers, not perhaps because they were habited in red clothes, but probably because there was some red colour about them, or that they contrasted strongly with what their keepers usually wore. It was stated at the time, that the keeper of the celebrated bull Sirius, belonging to the late Mr Robertson of Ladykirk, had on a red night-cap when he was killed by him. One day, when walking with a lady across a field, for a short cut to a road, my own bull, the one represented in the plate of the short-horn bull, than which a more gentle and generous creature of his kind never existed, made towards us, and seemed unusually excited. This conduct did not arise from the circumstance of a stranger being in the field, for many strangers, both male and female, visited him in the field. I could ascribe his extraordinary excitement to no other cause than to the red shawl worn by the lady; for when she left the field, he resumed his wonted quietness of conduct. I remember observing him more than usually excited, on another occasion, in his hammel, when his keeper, an aged man who had attended him for years, was beside him on a Sunday forenoon. I ascribed his excited state to the new red night-cap, instead of the usual black hat, which his keeper wore on the occasion; and on my desiring him to throw it away, the animal became again quite quiet. Be the *rationale* of the thing what it may, it is prudential in a *cattle*-man to be always habited in a sober suit of clothes.

(1454.) *Regularity in regard to time* is the chief secret in the successful treatment of cattle. Cattle, dumb creatures though they be, soon understand your plans in regard to what affects themselves, and there is none with which they reconcile themselves more quickly than regularity in the time of feeding; and none on the violation of which they will more readily shew their discontent. No cattle-man can keep regular

time without a watch; and if he has not one of his own, lend him one that will keep time well. His day's work in winter may be divided thus:—Let him be astir and have his breakfast over by daybreak, which cannot be very early at that season. The first thing he should do is to go to the cow-byre, and remove with the graip, into the gutter, any dung that would immediately interfere with the dairy-maid in milking the cows. She should be at the byre in time for this purpose. Leaving her there, he goes to the fattening beasts in the hammels, and first cleans out the same trough, always beginning at the same end, of all refuse, with his shovel; and immediately as he cleans one trough, he replenishes it with turnips from the store at hand, and breaks them with any of the instruments used. He thus proceeds from one hammel to another until the six are gone over, or as many as are occupied. It is not an easy matter to say exactly how long time this should take in doing, but say half-an-hour, 30 minutes. He then proceeds immediately to the calves in the large court, cleans out the dirt from the troughs, replenishes them with fresh turnips from the store, and breaks them; and he does this, having long troughs and fewer turnips, say in 15 minutes. He next goes to the 2-year-old court, and does the same in it; and, having a few more turnips to wheel out of the store and break, he will take a little more time, say 20 minutes. The bulls in the hammel may take 10 minutes to clean out their troughs and supply them with their small quantity of turnips. And the same time, 10 minutes, may suffice to give the heifers a little fresh fodder, for they should not get cold turnips on empty stomachs, more than cows; with another 10 minutes to supplying the old cows, or extra beasts, with turnips. Having thus given all the cattle that are at liberty something to do for some time, he returns to the cow-byre with a bundle of fodder of fresh oat-straw, which he distributes among the cows, and which they pick during the time he is clearing the byre of litter and dung; and to do all this may require 30 minutes. Shutting the principal door of the byre, and leaving the half-door to the court open for air, he leaves the cows with the fodder, and cleans out the servants' cow-byre, and fodders the cows, which may take other 30 minutes. Taking then a bundle of litter, he goes again to the byre, and spreading any refuse fodder as litter, and cleaning out the troughs, he supplies the cows with their allowance of turnips, and shaking up the straw which he has just brought as litter, he leaves them again to eat and rest a while. All this may require other 30 minutes; and 10 minutes may suffice to give the heifers their small quantity of turnips, and the old cows their fodder; and 10 minutes more to litter the servants' cows, the servants themselves having supplied the turnips as they choose. All the

cattle having now been once fed, brings the time to 25 minutes past 10 A. M., if the operations began at 7 o'clock. The next step to be taken is to supply those which get as many turnips as they can eat, with fodder and litter, and for this purpose he takes the fodder fresh from the straw-barn, and fills all the straw-racks in the large courts, whether in the open air or under the shed. The old fodder should be pulled out before the fresh is put in; but this is seldom attended to. He then strews the open courts and sheds with litter where it is chiefly required; namely, along the side of the troughs where the beasts stand to eat the turnips, and where they have lain under the sheds. The hammels are then supplied with fodder and litter, the refuse fodder probably being sufficient for the latter purpose, as long as the weather is dry. The bulls and heifers should also have fodder and litter. All this business with the straw, and making it up into bundles for the afternoon, may take up 50 minutes, and bring the time to ¼ past 11 A.M. What with cleaning out the troughs and supplying the hammels and courts again with turnips of the midday meal, and letting out all the cows—including those of the servants—into their respective courts, 12 o'clock will have arrived, which is the hour of dinner for all the work-people. The people have an hour to themselves, to 1 P.M., to refresh and rest. At 1 P.M., the cattle-man resumes his labours by bunching up *windlings* of straw, which are small bundles having a twisted form, of 10 lb. weight or more each, for each of the cows' supper, and also larger bundles in the ropes for fodder. Having prepared these just now or at any other leisure moment, he takes a bundle of fodder to the byre, supplies the troughs, and brings the cows in from the court, and ties them to their stakes. He does the same with the servants' cows. He then replenishes the straw-racks in the courts and hammels with what little fodder is required. He then litters the sheds comfortably for the night. He lays the windlings of straw in a corner of the servants' cow-byre for the night's suppering, and he does the same in the other byre; and the reason he does this in preference to letting them remain in the straw-barn is, to avoid the danger of taking a light into the straw-barn when the windlings are to be used. By the time all this business with the straw has been done, it is time to give the cows their second meal of turnips, so that they may have them eaten up before the milk-maid comes again at dusk to milk them. The feeding beasts in the hammels are then supplied with turnips broken for them, then the calves, then the young beasts in the other court, and then the bulls and heifers, in the same order as formerly. He then litters the servants' cows for the night, by which time it will be time for the other cows to be milked; immediately after which they are littered for

the night, and the doors closed upon them, and thus the labours of the day are finished.

(1455.) In thus minutely detailing the duties of the cattle-man, my object has been to shew you rather how the turnips and fodder should be distributed relatively than absolutely; but at whatever hour and minute the cattle-man finds, from experience, he can devote to each division of his work, you should see that he performs *the same operation at the same hour and minute every day*. By paying strict attention to time, the cattle will be ready for and expect their wonted meals at the appointed times, and will not complain until they arrive. Complaints from his stock should be distressing to a farmer's ears; for he may depend upon it, they will not complain until they feel hunger; and if allowed to hunger, they are not only losing condition, but rendering themselves, by discontent, less capable of acquiring it, even should their food happen to be regularly given them for the future. Whenever, therefore, you hear petitioning and impatient lowings from cattle at any steading, you may safely conclude that matters there, in so far as regards the cattle at least, are conducted in a very irregular manner. The rule, then, simply is, *Feed and fodder cattle at fixed times, and dispense their food and fodder in a fixed routine.* I had a striking instance of the bad effects of irregular attention to cattle. An old staid labourer who was appointed to take charge of the cattle, was quite able and very willing to undertake the task. He was allowed to take his own way at first; for I had observed that many labouring men display great ingenuity in arranging their work. Lowings from the stock were heard in all quarters, both in and out of doors; and they intimated that my ancient cattle-man was not endowed with the organ of order, whilst I observed that the poor creature himself was constantly in a state of perspiration. To put an end to this disorderly state of things, I apportioned his whole day's work by his own watch; and on his implicitly following the plan, he was not only soon able to satisfy the wants of every creature committed to his charge, but had abundant leisure besides to lend a hand at anything else that required temporary assistance. His heart overflowed with gratitude when he found he could easily make all the objects of his charge happy; and his kindness to them all was so sincere, that they would have done whatever he liked. A man better suited for this occupation I never saw.

(1456.) Now, you may consider that all these minute details regarding the treatment of cattle are frivolous and unnecessary. But the matter is really not so; and it is of importance for your own interests to tell you so, for you will admit, that where a number of minutiæ have to be

attended to, unless taken in some order, they are apt either to be forgotten altogether, or attended to in a hasty manner; and none of these conditions, you will also admit, are conducive to correct management. Observe, then, the number of minute things the cattle-man has to attend to. He has various classes of cattle under his charge—cows, fattening beasts, young steers, calves, heifers, bulls, and perhaps extra beasts besides; and he has to keep all these clean in their various places of abode, and supply them all with food and fodder 3 times in a short winter's day of 7 or 8 hours. Is it possible to attend to all these particulars, as they should be, without a matured plan of operations? The cattle-man requires a plan for his own sake, for were he to do one thing just when the idea struck him, his mind, being guided by no fixed rule, would be as apt to forget as to remember any thing he had to do. And besides, the injurious effects which irregularity of attendance tends to produce upon the condition of animals, seem to render a plan of operations absolutely necessary to be adopted. Before you can see the full force of this observation, you require to be told, that food given to cattle in an irregular manner,—such as too much at one time and too little at another, frequently one day and seldom in another,—and the same with fodder and litter, thus surfeiting them at one time, hungering them at another, and keeping them neither clean nor dirty, never fails to prevent them acquiring that fine condition which better management ensures. And still further to shew you its force, you may not be sensible of any deficiency of condition under the most irregular management, from the want of the means of comparing your beasts with others; but an appeal to figures will shew you the risk of loss you are unconsciously incurring. Suppose you have 3 sets of beasts, of different ages, which should get as many turnips as they can eat, and each set to contain 20 beasts; that is, 60 beasts in all. Suppose, moreover, that, by irregular management, each of these beasts acquires only ½ lb. less of live weight every day than they would under proper management, this would make a loss of 30 lb. a day of live weight, which, over 180 days, the duration of the fattening season, will make 5400 lb. of live weight, or (according to the common rules of computation) 3240 lb., or 231 stones of beef, which, at 6s. the stone (not a high price), shew a deterioration of L.69, 6s. in the value of the whole herd at the end of the season. The question, then, resolves itself into this, Whether it is more for your interest to lose this sum annually, or make your cattle-man attend to your beasts according to a regular plan, any form of which it is in your own power to adopt and pursue?

(1457.) What I have narrated above applies to the ordinary mode of

feeding cattle, but extraordinary means are sometimes applied to attain a particular object. You may have, for instance, a pair of very fine oxen which you are desirous of exhibiting at a particular show, not altogether for the sake of gaining the premium offered, but partly for the honour of carrying off the prize from contemporaries. In this case they should have a hammel comfortably fitted up for themselves; that is, possessing all the means of satisfying their wants both of food and shelter. Your ingenuity should be taxed to devise means that will anticipate every desire; and this you will be the better able to do, after you have determined on the sort of food you wish to support them upon. If, regardless of expense, you will present a choice of food, there should be a trough for sliced Swedish turnips—a manger for bean-meal—another for bruised oats—a third for broken oil-cake—a rack for hay—and a trough for water; for water at will I conceive essential when so much dry food is administered. Then there should be abundance of straw for litter and warmth, and a regular dressing of the skin every day, to keep it both clean and healthy, as *fat* oxen can reach but very few parts of their bodies with their tongue. So much for winter treatment. In summer, they should get cut clover in lieu of the turnips and hay, and all the other auxiliaries to the dry materials and straw, as already stated. But all these will not avail to attain your object, if constant attention be not given, and every thing conducted with the utmost regularity in regard to time. True, they get as much as they can eat, but then what they eat should be administered with judgment. It will not suffice to set an adequate portion of each sort of food daily before them, to be taken at will; one or more kinds should be given at stated times, that each may possess the freshness of novelty and variety,—not all at one time, but every one at such a time as one or both the animals may incline most to have. All these considerations demand attention, and afford exercise to the judgment. Oxen, when thus fattened, cannot travel any distance on foot: they must be conveyed on carriages built for the purpose, and even on these, if the distance is great, they will fall off in condition, as the confinement in, and motion of, the carriage proving irksome, prevent animals taking their food so heartily as they would do at home. I knew a 3-year-old-off bull that lost 30 stones live weight on being carried partly by steam-ship and partly by railway to a show.

(1458.) The *names* given to cattle at their various ages are these :—A new-born animal of the ox-tribe is called a *calf*, a male being a *bull-calf*, and a female a *quey-calf*, *heifer-calf*, or *cow-calf*, and a castrated male gets the name of *stot-calf*, or more commonly, simply a *calf*. The term calf is applied to all young cattle until they attain a year old, when

they are called *year-olds* or *yearlings*, saying *year-old bull*, *year-old quey* or heifer, *year-old stot; stirk* is applied to both a young ox and quey, and *stot* in some places means a bull of any age. In another year they are named 2-*year-old bull*, 2-*year-old quey* or *heifer*, 2-*year-old stot* or *steer*. In England females are called *stirks* from calves to 2-year-old, and the males *steers*. The next year they are called 3 *year-old bull*, females, in England, from 2 to 3-year-old, *heifers*, in Scotland 3-*year-old queys*, and when they are kept for breeding, and bear a calf at that age, they get the name of *cows*, the same as in England, and the males 3-*year old stots* or *steers*. Next year the *bulls* are *aged*, the *cows* retain that name ever after, and the *stots* or *steers* are *oxen*, which they continue to be to any age they are kept. A cow or quey that has been served by the bull is said to be *bulled*, and are then *in calf*, and from that circumstance are called in England *in calvers*. A cow that has either *missed* being in calf, or has *slipped* calf, is said to be *eill;* and one that has gone dry of milk is called a *yeld-cow*. A cow giving milk is a *milch-cow*. When 2 calves are born at one birth, they are *twins:* if three, *trins*. A twin bull and quey calf are called *free martins*, in which case the quey never produces young, but has no marks of a hybrid or mule. *Cattle*, *black cattle*, *horned cattle*, and *neat-cattle*, are all generic names for the ox tribe, and the term *beast* is used as a synonyme. An ox that has no horns is said to be *doddet* or *humbled*. An aged bull that is castrated is called a *segg;* and a quey that has had the ovaries obliterated, to prevent her breeding, is called a *spayed heifer* or *quey*.

(1459.) Cows are kept on every species of farm, though for very different purposes. On *carse* and *pastoral* farms they are merely useful in supplying milk to the farmer and his servants. On *dairy* farms, they afford butter and cheese for sale. On some *farms near large towns*, they chiefly supply milk for sale. And on *farms of mixed husbandry*, they are kept for the purpose of breeding young stock.

(1460.) On carse and pastoral farms, cows receive only a few turnips in winter, when they are dry, and are kept on from year to year; but where the farmer supplies milk to his work-people, as a part of wages, they are disposed of in the yeld state, and others in milk, or at the calving, bought in to supply their place, and these receive a large allowance of turnips, with perhaps a little hay. On these farms, little regard is paid to the breed of the cow, the fact of being a good milker being the only criterion of excellence.

(1461.) On true dairy farms, the winter season is not a favourable one for making butter and cheese for sale; for do what you like to neutralize the effect of the usual rooted green crops on these products, and especially butter, they remain unpalatable to the taste. The cows are therefore in calf during this season, and receive the treatment described above until the period of calving in spring.

(1462.) *In and near* large towns, the dairy-man must always have milk to

supply his customers, and it is his interest to render the milk as palatable as possible. For the purpose of maintaining the supply, he buys cows at all seasons, just calved or about to calve. He disposes of the calves, without attempting to fatten them; and to render the milk he sells palatable, he cooks all the food partaken of by the cows. When the cows run dry, they are fattened for the butcher, and not allowed to breed again.

(1463.) The cows in the public dairies in Edinburgh are supported in winter on a variety of substances, namely, turnips, brewers' and distillers' grains called draff, dreg, malt comins, barley, oats, hay seeds, chaff, cut hay. One or more of these substances, with turnips, are cooked together, and the usual process in doing this, and administering the cooked food, is as follows:—Turnips, deprived of tops and tails, and washed clean, are put into the bottom of a boiler, and covered near to its top with a quantity of malt comins, cut hay, hay seeds, chaff, or barley, or more than one of these, as the articles can be procured. Water is then poured into the boiler sufficient to boil them, and a lid placed upon it. After being thoroughly boiled and simmered, the mess is put into tubs, when a little pounded rock-salt is strewed over it, and chopped into a mash with a spade. As much dreg is then poured upon the hot mash as to make it lukewarm, and of such a consistence as a cow may drink up. From 1 to 1½ stable pailfuls of this mixture,—from 40 to 60 pints imperial,—according to the known appetite of the cow, is then poured into the trough belonging to each. The trough is afterwards removed and cleaned, and the manger is ready for the reception of fodder—hay or straw. This mess is given 3 times a day, *after* the cows have been milked, for dairy-men understand that animals should not be disturbed while eating their food. The times of milking are 6 A.M., 12 noon, and 7 P.M. The sweet milk and cream obtained by these means, and received direct from the dairy, are pretty good. The former sells in Edinburgh at 1d., and the latter at 1s. the imperial pint. Dr Cleland states the price of sweet milk in Glasgow at 1½d. the imperial pint.

(1464.) It will be observed that none of the articles usually given to cows are so expensive as oil-cake, cabbages, kohl-rabi, or coleseed. These products were employed by the late Mr Curwen in his experiments to ascertain the cost of raising milk for supplying the poor, and the results shew they left him very little profit.*

(1465.) There is little milk in winter on a farm which supports cows for breeding stock, being only derived from one or two cows that are latest of calving in spring. All the spare milk may probably be eagerly bought by cottars who have no cows; but should that not be the case, a little butter may be made once in 10 days or a fortnight, which, if not palatable for the table, may be used in making paste, and other culinary purposes. A little saltpetre, dissolved in water, certainly modifies the rank taste of turnips in both butter and milk.

(1466.) Cattle are fed on other substances than turnips, either with themselves or in conjunction with turnips. Oil-cake and potatoes are the most common substances used for this purpose. Linseed-oil and linseed have been recommended, and many are fed at distilleries on *draff* and *dreg*, as the refuse of distillation are termed; and these are also sold to the farmers for the purpose of feeding. Oats, barley-meal, and bean-meal, have also been pressed into the service of feeding cattle.

* Curwen's Agricultural Hints, pp. 47-52.

(1467.) The *potatoes used in feeding cattle* are either the common kinds known in human food, or others raised on purpose, such as the yam and ox-noble; and they are given either alternately with turnips, or together. In feeding cattle with potatoes of any kind, and in any way, there is considerable risk of flatulency and choking. To prevent the latter, the potatoes should be smashed with a hammer, or with an instrument like a paviour's rammer, and though juice should come out in the operation, no loss is incurred, as it is considered of no service in feeding. To prevent flatulence from potatoes is no easy matter; but a friend of mine used a plan which completely answered the purpose, which was, mixing cut straw with the broken potatoes. The straw obliging the cattle to chew every mouthful before being swallowed, may prevent such a large quantity of gas being generated in the paunch as bruised potatoes alone would do, and it is this gas which occasions that distressing complaint called *hoven*. A farm-steward, who had considerable experience in feeding cattle on potatoes on a led-farm, always placed as many potatoes, whole, before cattle as they could consume, and they never swelled on eating them, because, as he conjectured, and perhaps rightly, they do not eat them so greedily when in their power to take them at will, as when doled out in small quantities. This fact confirms the propriety of mixing cut straw amongst potatoes that are given in small quantities, in order to satisfying the appetite, and filling the paunch with unfermentable matter. The only precaution required in giving a full supply of potatoes, is to give only a few and frequently at first, and gradually to increase the quantity.

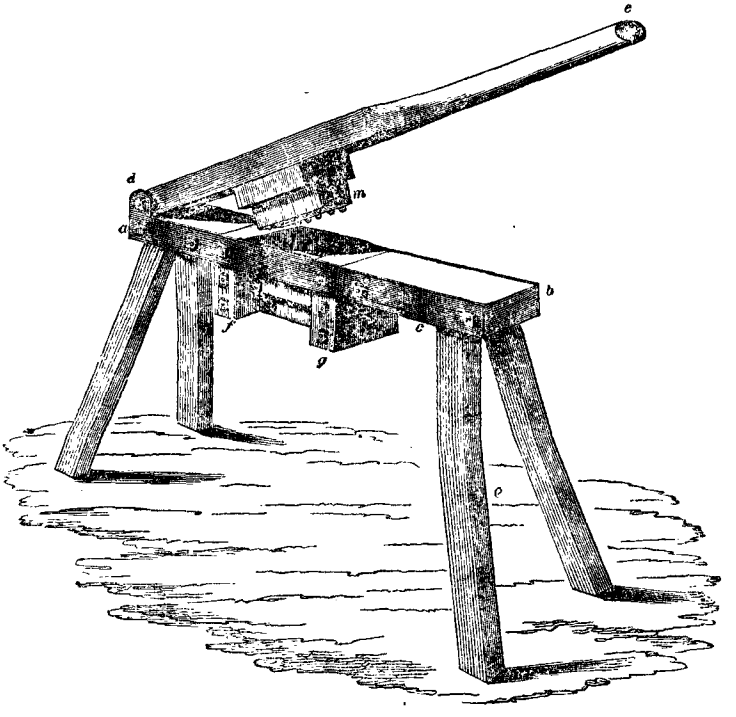
(1468.) *Oil-cake* has been long and much employed in England for the feeding of cattle, and it is making its way in that respect into Scotland. It consists of the compressed husks of linseed, after the oil has been expressed from it, and is formed into thin oblong cakes. The cakes are broken into pieces by a machine described below in fig. 264. Cattle are never entirely fed on oil-cake, but in conjunction with other substances, as turnips, potatoes, cut hay, or cut straw. When given with cut hay or straw, an ox will eat from 7 to 9 lb. of cake a-day, and the hay or straw induces rumination, which the cake itself is not likely to do. When given with other substances, as turnips or potatoes, 3 lb. or 4 lb. a-day will suffice. A *mixture* of oil-cake and cut meadow-hay forms a very palatable and nutritious food for oxen, and is a favourite one in England. Oil-cake costs from L.7 to L.10 a ton.

(1469.) [*Turnip-slicers for Cattle.* In the description formerly given of machines for cutting turnips for sheep, that described in (1364.) may be again adverted to, fig. 250, the wheel turnip-cutter. This machine is equally well adapted to slice for cattle as for sheep, and is frequently fitted up to slice for cattle only. More frequently it is finished as described with the cross-cutters, fig. 252; and when wanted to slice for cattle, the *cross-cutters* are removed. This is easily accomplished by first lifting the slicing-knives from the disc of fig. 250, then unscrewing all the nuts of the cross-cutters, and removing them from their places. The slicing-knives are then again placed as before, and the machine is prepared to cut the turnips into plain slices. This machine costs from L.4, 4s. to L.5.

(1470.) *Lever Turnip-slicer.*—One of the cheapest and most efficient turnip-slicers is represented in fig. 259. It was brought before the Highland and Agricultural Society of Scotland by Mr Wallace of Kirkconnell, as an improvement on a

pre-existing machine of the same kind.* It has since undergone some further improvements in the hands of James Slight and Company, Edinburgh; and for the purpose of regular and perfect slicing of turnips, it may be held as the best and cheapest now employed. The machine, as produced by Mr Wallace, is represented in fig. 259; where *a b* is the stock or sole of the machine, about 34 inches long, 6 inches broad, and 2 inches in thickness. The sole is in

Fig. 259.



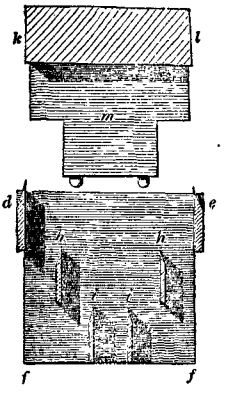
THE LEVER TURNIP-SLICER FOR CATTLE.

2 pieces, connected by an iron bar or strap *a c*, which is repeated on the opposite side, and the whole bolted together, as in the figure. The 2 pieces forming the sole are separated longitudinally from each other, so as, with the two side-straps of iron, to form a rectangular opening of 9 inches by 6 inches, bounded on the two ends by the parts of the sole, and on the two sides by the side-straps, which, to the extent of the opening, are thinned off to a sharp edge, and thus form the two exterior cutters *d*, *e*, as seen in fig. 260, which is a transverse section through the cradle of the machine. The sole is supported at a height of 2 feet upon 4 legs, fig. 259, and the lever *d e*, is jointed at *d* by means of a bolt passing through it and the ears of the side-straps, as seen at *d*. The lever is 4 feet in length, its breadth and thickness equal to that of the sole, but is re-

* Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 363.

duced at the end *e* to a convenient size for the hand. Two cutter-blocks *f* and *g* are appended to the sole by mortice and tenon, and further secured by the bolts which pass through the side-strap at that place. Into these blocks the remaining cutters *h h* and *i i*, fig. 260, are inserted in corresponding pairs, and also secured by bolts; the cutters, thus arranged, form a cradle-shaped receptacle, into which the turnip is laid to be sliced. The lever *d e* is armed with a block of wood *m*, loosely fitted to the cradle; and its lower face is studded with iron knobs, the better to prevent the turnip sliding from under it. The transverse section *d e f f*, fig. 260, shews the position of six cutters *d e*, *h h*, and *i i*, as inserted in the wooden block *d e f f*; and *k l* is the lever, seen in section, with the block *m* attached.

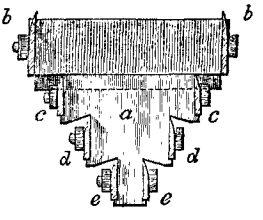
Fig. 260.



TRANSVERSE SECTION SHEWING THE POSITION OF THE CUTTERS.

(1471.) The late improvement by Messrs Slight and Company consists in the application of cast-iron knife-blocks, which give greater strength to the machine, and a more ready and secure fixture of the interior knives, and of introducing 8 cutters instead of 6, which makes a more convenient size of slice. Fig. 261 is a section of the cradle, as it appears with the cast-iron knife-block; *a* is the body of the block, which is attached to the sole through the medium of a flange behind, and fixed by bolts. The external cutters *b b* are a part of the side-straps, as before; and the interior cutters are fixed in pairs, *c c*, *d d*, and *e e*, by their respective bolts passing through the cutters and the block.

Fig. 261.



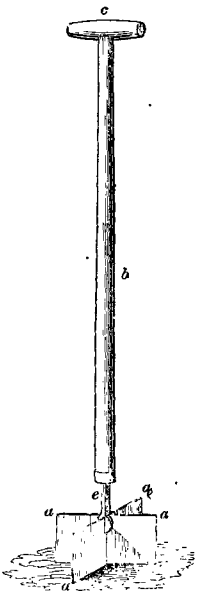
THE SECTION OF THE IMPROVED CRADLE.

(1472.) In using this machine, the workman takes hold of the lever at *e*, fig. 259, with the right hand, and, having raised it sufficiently high, he, with the left hand, throws a turnip into the cradle. The lever is now brought down by the right hand, which, with a moderate impetus, and by means of the block *m*, sends the turnip down upon the cutters, through the openings of which it passes while the cutters are dividing it, and the whole falls away in perfectly uniform slices. In most cases, it is found more convenient to have a boy to throw in the turnips, and this will somewhat expedite the work. One advantage of this turnip-slicer—and it is an important one—is, that, with unerring certainty, it cuts every slice of uniform thickness; the slab-slices, indeed, may of course vary, but all are free of the smallest portion of waste. Its cheapness also is of importance, especially when it is considered that, in a given time, it will slice weight for weight of turnips with the most elaborate machine in use, the power applied being also equal. The price is 28s. to 30s. It is also extremely portable, and can be carried about by one person. An objection has been urged to this slicer, namely, that the turnips must be all put into it one by one; and it is perhaps unnecessary to remark, that this objection applies to all turnip-slicers. For though the hopper of some may be capable of containing a number of turnips at one time, yet that number may be considered as having been deposited there in-

dividually. The price of the lever turnip-slicer for sheep, as in fig. 245, is L.3, 10s.

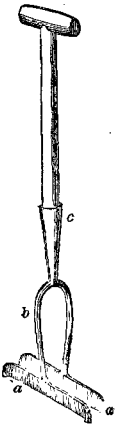
(1473.) *Cross Turnip-cutter.*—There is another very simple and useful turnip-cutter, which is frequently used when thin slicing is thought of less importance, but is more especially useful where the cooking system is adopted for either cows or horses, thin slicing being in such cases not called for. This instrument is represented in fig. 262. The cutting part of it consists of 2 steel-edged blades, 8 inches in length and 4 inches in depth. They are slit half-and-half at their middle point, so as to penetrate each other, standing at right angles, forming the *cross cutter* *a a a a*. They are then embraced in a four-split palm, and riveted. The palm terminates in a short shank *c*, which is again inserted into the hooped end of a wooden handle *b*, 3 feet in length, which is finished with a crosshead *c*. The price of this instrument is 8s. 6d. The mode of using it is obvious. It is held by the hand in a vertical position; and when placed upon a turnip, one thrust downward cuts it in quarters. This instrument is also varied in its construction, being sometimes made with 3 and even with 4 blades, dividing the turnip into 6 or into 8 portions.

Fig. 262.



THE HAND TURNIP-CHOPPER, WITH CROSS BLADES.

Fig. 263.



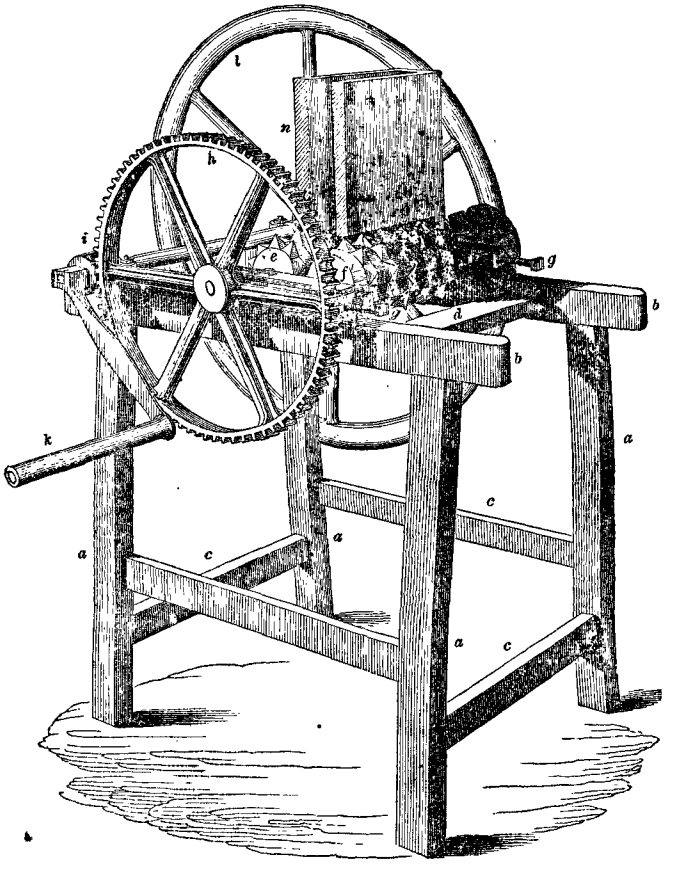
THE HAND TURNIP-CHOPPER, WITH PARALLEL BLADES.

(1474.) Another individual form of the same species is represented by fig. 263. It has two blades *a*, *a*; but they, instead of crossing, stand parallel to each other, and therefore divide the turnips into three portions, resembling slices, of considerable thickness, the middle one being $1\frac{1}{2}$ inch thick. In the construction of this cutter, a blunted stud is formed at the extremities of each blade, and there projects below the cutting edge about $\frac{1}{4}$ inch, serving as guards to save the cutting edges from receiving injury when they have passed through the turnip, or otherwise striking any hard surface. These guards, it may be remarked, would form a useful addition to all this class of cutters. The arms *b* of the blades rise to a height of 9 inches, widening upward to $3\frac{1}{2}$ inches, to give freedom to the middle slice to fall out. The two arms coalesce above, and are then formed into the socket *c*, to receive the handle, which—as in the cross cutter, fig. 262—terminates in a crosshead.

(1475.) *Oil-cake Breaker.*—Machines for preparing oil-cake for more easy mastication by cattle or sheep are made in a variety of forms. One of those forms is similar in principle to that of the early bone-crushing machines; namely, a revolving axle, armed with several series of teeth, which are so arranged as to pass in succession through the interstices of a line of strong teeth

or prongs, against which the cake lies, and is reduced to fragments by the suc-

Fig. 264.



THE OIL-CAKE BREAKER.

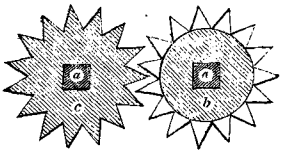
cessive action of the revolving teeth. Of this form there are various modifications, all serving the same purpose with nearly equal success.

(1476.) A different form of the machine, and which is held to be superior in the principle of its construction, is here exhibited in fig. 264, which is a view of the machine in perspective, wherein *a*, *a*, *a*, *a*, are the four posts of a wooden frame, on which the machinery is supported. The frame is 39 inches in length and 20 inches in width over the posts at top, the height being 33 inches. *b b* are two top-rails, 34 inches in length, and the scantling of their timbers should not be less than $2\frac{1}{4}$ inches square. The posts are supported towards the bottom by the four stay-rails *c*, *c*, *c*; and the top-rails are held in position by cross-rails *d*, one only of which is seen in the figure. Of the machinery, the acting parts consist of 2 rollers, studded all over with pyramidal knobs or teeth. These are arranged in zones upon each roller, and having a smooth space or zone be-

tween each of the knobbed zones; the knobs of the one roller corresponding to the smooth space in the other. The rollers *e* and *f* are constructed with an axle or shaft, that of the first *e* being 25 inches long, and of the second *f* 23 inches, and each 1¼ inch square. Journals are formed upon these shafts, to run in the bearings which are placed on the top-rails *b b*, as afterwards described. In this figure, *g g* are two pinching screws, which serve to regulate the distance at which the rollers are to work, and, consequently, the degree of coarseness to which the cake is to be broken. The wheel *h*, of 20 inches diameter, is placed upon the shaft of the roller *e*, and the pinion *i*, of 3 inches diameter, with its shaft, and the winch-handle *k*, act upon the wheel *h*, giving a very considerable mechanical advantage to the power which is applied to the machine. The fly-wheel *l* is likewise placed upon the shaft of the pinion *i*, and is requisite in this machine to enable the power to overcome the unequal resistance of the work. On the farther end of the shaft of each of the rollers, there is mounted a wheel of 4½ inches diameter, for the purpose of carrying both rollers at the same speed. These wheels, one of which is seen at *m*, are formed with long teeth, to admit of the roller *f* approaching to or receding from the other, which is stationary *in place*. A feeding-hopper *n* is placed over the line of division of the two rollers; it is 16½ inches long, 3 inches wide, and 14 inches deep. In forming the hopper, two upright pieces, 3 inches by 2 inches, are bolted to the inside of the top-rail, their position being between the shafts of the 2 rollers, and these form the ends of the hopper. They are then boarded on each side, which completes the machine. The hopper is here represented in section, the near portion of it being supposed entirely removed, in order to exhibit more distinctly the construction of the rollers.

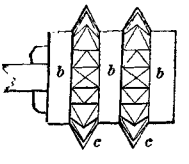
(1477.) Fig. 265 is a further illustration of the construction of the rollers being a transverse section of the two, *a a* are the shafts, the shaded part *b* one of the plain discs which go to form the smooth zones on the body of the roller; it

Fig. 265.



THE TRANSVERSE SECTION OF THE ROLLERS.

Fig. 266.



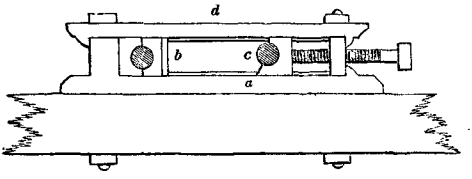
THE PLAN OF PART OF A ROLLER.

is 4 inches diameter and 1 inch thick; *c* is one of the knobbed discs, its body being of the same diameter and thickness as the former; but having the 4-sided pyramidal knobs set around it, the diameter, measuring to the apex of the knobs, is extended to 6 inches. One roller for the machine here described requires 5 plain and 6 knobbed discs, beginning and ending with a knobbed disc. In the other the arrangement is reversed, bringing out the alternation of the plain and knobbed zones before alluded to, as more distinctly represented in fig. 266, which is a plan of part of the rollers, *c c* being two of the knobbed discs, and *b b b* three of the plain.

(1478.) Fig. 267 represents one of the bearings or plummer-blocks for the journals of the rollers, *a* is the bed of the plummer-block, *b* and *c* the brass bushes,

and *d* the cover. The bush *b*, which corresponds to the roller *e*, fig. 264, is,

Fig. 267.



PART OF THE TOP-RAIL, WITH PLUMMER-BLOCK.

always stationary, while *c*, which is acted upon by the screw, is advanced towards, or withdrawn from, *b*, as the size to which the cake is to be broken may require. These plummer-blocks are bolted down to the top-rails of the frame, to which also the separate bearings of the pinion-shaft are likewise bolted.

(1479.) It may be proper to remark here, that the machine now described is of a good medium size, and with a man to drive and a boy to feed in the cakes, it will break about half a ton in an hour. The price is from L.4, to L.4, 10s. The amount of its performance can be augmented or diminished to only a small extent, for as its feed is necessarily confined to one cake at a time, the only change that can be made on its production must depend upon the celerity of its motions. Hence, it is one of those machines that cannot easily be adapted to *large* and to *small* establishments with any view, in this latter case, to amelioration of form; for the almost only means of doing so must be by giving it a quicker or slower motion, which can only affect the expense of construction to a very small amount, so small as hardly to be appreciable. In addition to what is shewn of this machine in fig. 264, the rollers are frequently covered with a movable wooden case, which gives a more tidy appearance to it, and, moreover, it is always desirable that the frame below should contain a *shoot* formed of light boarding, that will receive the broken cake from the rollers and deliver it at one side of the machine into a basket or other utensil in which it can be removed to the feeding stations.—J. S.]

(1480.) Mr Brodie, Abbey Mains, East Lothian, made an experiment on feeding cattle, from October 1836 to June 1837, on different kinds of food. There were 4 lots of cattle, consisting of 5 each. The first lot was fed on turnips and straw, which, being the usual treatment, formed the standard of comparison. The second lot had half the weight of turnips and 30 lb. of oil-cake a-day. A third lot was fed on the last quantity of turnips and bean-meal and bruised oats. And the fourth had distillery grains and ground beans. The value of the cattle, when put up to feed, was L.11 a-piece, and they were of the Aberdeenshire polled breed. This is a summary of the cost of feeding:—

Lot 1. White turnips at 8s. 4d., Swedes at 12s. 6d. per ton, cost .	L.53	9	10
Average cost of each beast per week, . . .	0	6	3
Lot 2. Turnips as above, oil-cake, L.7, 15s. per ton, cost . .	L.48	16	0
Average cost of each beast per week, . . .	0	5	9

Lot 3. Turnips as above, bean-meal, 5s., bruised oats, 3s. 6d. per bushel, cost L.58 8 1
Average cost of each beast per week, . . . 0 6 8

Lot 4. Turnips and bean-meal, as above, draff, 4s. 6d. per quarter, dreg, 2s. 6d. per puncheon, cost L.63 3 2
Average cost of each beast per week, . . . 0 7 2

The ultimate results are as follows :—

Lots.	Live weight.	Beef.	Tallow.	Hide.
	st.	st. lb.	st. lb.	st. lb.
1.	536	283 3	36 10	27 13
2.	552	295 10	41 6	29 6
3.	517	280 7	37 2	26 13
4.	545	280 0	36 11	25 7

" Upon the whole," concludes Mr Brodie, " it is evident, by these experiments, that feeding with turnips as an auxiliary has been the most advantageous mode of using turnips, as, by the above statement, it is apparent that if the cattle of the first lot had only been allowed half the quantity of turnips which they consumed, and had got oil-cake in lieu of the other half, as was given to the second lot, the expense of their keep would have been lessened L.4, 13s., and from superior quality of beef, their value would have been increased L.10, making together L.14, 13s."* Three remarks occur to me to make on the progress of this experiment; the first is, that if the cattle had been sold on the 7th April 1837, when they were adjudged by competent farmers, they would not have repaid the feeder his expenses, as the prime cost of lot first, with the cost of feeding to that time, amounted to L.95 : 1 : 8, and they were only valued at L.82 ; lot second cost L.90, 12s., and they were valued at L.88, 10s. ; lot third cost L.93, 4s., and were valued at L.77 ; and lot fourth cost L.97 : 4 : 5, and their value was only L.81, 10s. And this is almost always the result of feeding cattle, because *ripeness* only exhibits itself towards the *end of the feeding season*, and it is only after that state of condition is indicated that the quality of the meat improves so rapidly as to enhance its value so as to leave a profit. As with sheep so with cattle; with good beasts the inside is first filled up before the outside indicates fineness. Another remark is, that this result should be a useful hint to you to weigh well every consideration before disposing of your fattening beasts in the middle of the feeding season. The last remark I have to make is, that the cattle of lot first, continuing to receive the same sorts of food they had always been accustomed to, throve more rapidly at first than the beasts in the other lots, but afterwards lost their advantage ; thereby corroborating the usual experience of stock not gaining condition immediately on a change of food, even of a better kind, such as from turnips to grass.

* Quarterly Journal of Agriculture, vol. viii. p. 331.

(1481.) Mr Moubray of Cambus, in Clackmannanshire, made experiments in the winter of 1839-40 on feeding cattle with other than the ordinary produce of the farm, but as the cattle were not all sold at the same time I need not relate the details; and I mention the experiments for the sake of some of the conclusions that may be deduced from them. It would appear that cattle may be fed on turnips and hay as cheaply as on turnips and straw, for this reason, that when straw is given as fodder more turnips are consumed, and, therefore, when turnips are scarce, hay may be used with advantage. It also appears that cattle may be fed cheaper on distillery refuse of draff and dreg than on turnips and straw, but then the food obtained from the distillery requires more time to bring cattle to the same condition, which in some circumstances may be an inconvenience.*

(1482.) *Linseed oil* has been successfully employed to feed cattle by Mr Curtis of West Rudham, in Norfolk. The mode of using the oil is this:—First ascertain how much cut-straw the oxen, intended to be fed, will consume a-week, then sprinkle the oil, layer upon layer, on the cut straw, at the rate of 1 gallon per week per ox. The mixture, on being turned over frequently, is kept 2 days before being used, when a slight fermentation takes place, and then the oil will scarcely be discerned, having been entirely absorbed by the straw, which should of course be the best oat straw. This mixture, when compared with oil-cake, has stood its ground. The cost of the oil is not great, its average price being about 34s. the cwt. of 12¼ gallons, a gallon of fine oil weighing 9.3 lb., which makes the feeding of an ox cost only 2s. 10d. per week.†

(1483.) Mr Curtis has fed cattle for upwards of 20 years upon what he calls *green malt*, which consists of steeping light barley "for 48 hours in soft water, when the water is let off and the barley is thrown into a round heap, in a conical form, till it gets warm and begins to sprout freely. It is then spread out and turned over repeatedly as it grows. The only care required is, that the sprout or future blade does not get cut off, as the malt will then lose much of its nutritious quality." He finds this substance, which costs with its labour 1s. a-stone, preferable to oats at 10d. in their natural state.‡

(1484.) A method of feeding cattle has been adopted by Mr Warnes jun., Trimingham, Norfolk, which, in a manner, combines both the substances used by Mr Curtis, and deserves attention. The substances consist of linseed-meal and crushed barley. The barley may either be used malted, that is, in a state of "green malt," as designated by Mr Curtis, or crushed flat by bruising cylinders. Crushed oats, boiled pease, and bean-flour may all be substituted for the barley, and used with the linseed-meal. The mode of making this compound is thus recommended by Mr Warnes. "Put 168 lb. of water into an iron cauldron or copper or boiler, and as soon as it boils, not before, stir in 21 lb. of linseed-meal; continue stirring it for 5 minutes; then let 63 lb. of the crushed barley be sprinkled by the hand of one person upon the boiling mucilage, while another rapidly stirs and crams it in. After the whole has been carefully incorporated, which will not occupy more than 5 minutes, cover it closely down and throw the furnace door open. Should there be much fire, put it out. The mass will continue to simmer, from the heat of the cauldron, till the barley has entirely ab-

* Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 61.

† Ibid., vol. xiv. p. 587. ‡ Ibid., vol. xiv. p. 588.

sorbed the mucilage. The work is then complete, and the food may be used on the following day. When removed into tubs, it must be rammed down to exclude the air, and to prevent its turning rancid. It will be seen that these proportions consist of 3 parts of barley to 1 of linseed, and of 2 parts of water to 1 of barley and linseed included. Also, that the weight of the whole is 18 stones when put into the cauldron; but after it has been made into compound and become cold, it will be found in general reduced to something less than 15 stones, which will afford 1 bullock for a fortnight 1 stone per day, containing 1½ lb. of linseed. It will keep a long time if properly prepared. The consistency ought to be like that of clay when formed for bricks." In regard to the nutritive properties of this compound Mr Warnes testifies thus;—"The last of my experimental bullocks for 1841 was disposed of at Christmas at 8s. 6d. per stone. He weighed 60 stones 5 lb., of 14 lb. to the stone, and cost L.7 : 17 : 6 thirteen months previously; so that he paid L.17, 10s. for little more than one year's keeping. His common food was turnips or grass; 14 lb. a-day of barley or pease compound were given him for 48 weeks, and an unlimited quantity the last 5 weeks; when, considering the shortness of that time, his progress was perfectly astonishing, not only to myself a constant observer, but to many graziers and butchers who had occasional opportunities of examining him. Altogether the weight of compound consumed did not exceed 2 tons 4 cwt., at a cost of only L.3, 16s. per ton."*

(1485.) This successful result obtained by Mr Warnes, shews that cattle may be *profitably* fed on prepared food, though the results of several experiments which have been made by farmers in Scotland lead to an opposite conclusion; yet Mr Warnes' statement contains no comparison, for it is quite possible that the nutritious materials employed by him, namely, linseed-meal and bruised barley, would have fed a bullock equally well in their naturally cold state as when cold, after being cooked warm. As to the expediency of cooking food for cattle, Mr Warnes goes so far in opinion as to say, that "neither oil nor linseed should be used in a *crude* state, but formed into mucilage by being boiled in water" (p. 10); but this opinion was evidently given when the results obtained by Mr Curtis on feeding cattle with linseed-oil in a crude state, were unknown to him; for although he admits "that linseed oil will fatten bullocks experience has placed beyond a doubt. Amongst the fattest beasts ever sent to the London market from Norfolk was a lot of Scotch heifers, grazed (?) on linseed oil and hay;"—yet he adds, "but the quantity given per day, the cost per head, or anything relative to profit or loss, I never heard." (p. 10.) I should therefore like to see a comparison instituted between the nutritive properties of linseed-meal and bruised barley, or pease or bean meal, in their ordinary state, and after they had been boiled and administered either in a hot or cold state, and also between the *profits* arising from both. Until this information is obtained, we may rest content with the results obtained by some very accurate experiments, conducted by eminent farmers, on the same food administered in a warm and in a cold state, and which go to prove that food is *unprofitably* administered to cattle in a *cooked* state. I shall now lay some statements corroborative of this conclusion before you.

(1486.) The first I shall notice, though not in detail, are the experiments

* Warnes' Suggestions on Fattening Cattle, p. 11-12.

of Mr Walker, Ferrygate, East Lothian. He selected, in February 1833, 6 heifers of a cross between country cows and a short-horn bull, that had been on turnips, and were advancing in condition, and divided them into 2 lots of 3 heifers each, and put one lot on raw food and the other on steamed, and fed them three times a-day, at day-break, noon, and an hour before sunset. The food consisted of as many Swedes as they could eat, with 3 lb. of bruised beans and 20 lb. of potatoes, ½ stone of straw and 2 ounces of salt to each beast. The three ingredients were mixed together in a tub placed over a boiler of water, and cooked by steaming, and the bruised beans were given to the lot on raw food at noon, and one-half of the potatoes in the morning and another half in the afternoon. It was soon discovered that the lot on the cooked food consumed more turnips than the other, the consumption being exactly 37 cwt. 16 lb., whilst, when eaten raw, it was only 25 cwt. 1 qr. 14 lb., the difference being 55 lb. every day, which continued during the progress of the experiment for 3 months.

(1487.) Steers were experimented on as well as heifers, there being 2 lots of 2 each. They also got as many Swedish turnips as they could eat, but had 30 lb. of potatoes and 4½ lb. bruised beans, 2 oz. of salt, and ½ stone of straw each, every day.

(1488.) The cost of feeding the heifers was as follows :—

3 heifers on *steamed* food—	Cwt.	qr.	lb.		L.	s.	d.
Consumed of Swedish turnips,	37	0	16,	at 4d. per cwt.	0	12	4¾
... ... Potatoes .	3	3	0,	at 1s. 3d.	0	4	8
... ... Beans, 1 bushel,	0	2	7,	. .	0	3	0
... ... Salt, ...					0	0	0¾
Coals and extra labour, ...					0	2	0
Cost of 3 heifers 1 week, or 7s. 4½d. per week each,					L.1	2	1½

3 heifers on *raw* food—	Cwt.	qr.	lb.		L.	s.	d.
Consumed of Swedish turnips,	25	1	14,	at 4d. per cwt.	0	8	6¼
... ... Potatoes, beans, and salt, as above, .					0	7	8¾
Cost of 3 heifers 1 week, or 5s. 5d. each per week,					L.0	16	3

2 stots on *steamed* food—	Cwt.	qr.	lb.		L.	s.	d.
Consumed of Swedish turnips,	28	2	0,	at 4d. per cwt.,	0	7	10
... ... Potatoes, .	3	3	0,	at 1s. 3d.	0	4	8
... ... Beans, .	0	2	7,	. . .	0	3	0
... ... Salt, ...					0	0	0½
Coals and extra labour, ...					0	1	6
Cost of 2 stots for 1 week, or 8s. 6¼d. each per week,					L.0	16	0½

2 stots on *raw* food—	Cwt.	qr.	lb.		L.	s.	d.
Consumed of Swedish turnips,	17	2	0,	at 4d. per cwt.,	0	5	10
... ... Potatoes, beans, and salt, as above, .					0	7	8½
Cost of 2 stots for 1 week, or 6s. 9½d. each per week,					L.0	13	6½

(1489.) The following table shews the progress of condition made by the heifers and stots.

CATTLE.	Average live-weight of 3 at commence-ment of feeding.	Average live-weight of 3 at end of feeding.	Average in-crease of live-weight in 3 months.	Average dead-weight of beef.	Average weight of tallow.	Average weight of hide.	Average weight of offal.
	St.	St. lb.	St. lb.	St. lb.	St. lb.	St. lb.	St. lb.
Heifers on steamed food,	74	90 0	16 0	50 0	7 11	3 12	26 9
Heifers on raw food,	74	89 3	15 0	50 1	8 4	4 4	26 10
Stots on steamed food,	84	103 4	19 0	56 19	8 11	5 12	28 3
Stots on raw food.	90	106 5	15 0	58 6	8 8	5 4	30 4

(1490.) The comparative profits on cooked and raw food stand thus:—

Live-weight of heifers, when put to feed on *steamed* food, 74 st.=42 st. 4 lb. beef, at 5s. 6d. per stone, sinking offal,	L.11	12	7
Cost of keep 12 weeks 5 days, at 7s. 4½d. per week,	4	19	0
Total cost,	L.16	11	7
Live-weight of the same heifers, when finished feeding on steamed food, 90 st.=50 st. 9 lb., at 6s. 6d. per stone, sinking offal,	16	9	1½
Loss on steamed food on each heifer,	L.0	2	6½
Live-weight of 1 heifer, when put to feed on *raw* food, 74 st.=42 st. 4 lb. beef, at 5s. 6d. per stone, sinking offal,	L.11	12	7
Cost of keep 12 weeks 5 days, at 5s. 5d. per week,	3	8	10½
Total cost,	L.15	1	5½
Live-weight of the same heifer when finished feeding on raw food, 89 st. 3 lb.=50 st. 1 lb., at 6s. 6d. per stone, sinking offal,	16	5	5½
Profit on raw food on each heifer,	L.1	4	0
Live-weight of 1 stot when put up to feed on *steamed* food, 84 stones= 50 st. 4 lb., at 5s. 6d. per stone, sinking offal,	L.13	4	0
Cost of keep 12 weeks 5 days, at 8s. 6¼d. per week,	5	8	4
Total cost,	L.18	12	4
Live-weight of the same stot after being fed on steamed food, 104 st. 7 lb.= 56 st. 10 lb., at 6s. 6d. per stone, sinking offal,	18	8	7½
Profit on each stot on steamed food,	L.0	3	8½

Live-weight of 1 stot when put on *raw* food, 90 st.=51 st. 6 lb., at 5s. 6d. per stone, sinking the offal, ...	L.14	2	10¼
Cost of 12 weeks 5 days' keep, at 6s. 9¼d. per week, .	4	6	1
Total cost,	L.18	8	11¼
Live-weight of the same stot after being fed on raw food 106 st. 7 lb.= 58 st. 6 lb. at 6s. 6d. per stone, sinking offal, . . .	18	19	9¼
Profit on each stot on raw food, .	L.0	10	10

(1491.) The facts, brought out in this experiment, are these:—It appears that turnips lose weight on being steamed. For example, 5 tons 8 cwt. only weighed out 4 tons 4 cwt. 3 qrs. 16 lb. after being steamed, having lost 1 ton 3 cwt. 12 lb. or $\frac{1}{5}$ of weight; and they also lost $\frac{1}{5}$ of bulk when pulled fresh in February; but on being pulled in April, the loss of weight in steaming decreased to $\frac{1}{6}$. Potatoes did not lose above $\frac{1}{50}$ of their weight by steaming, and none of their bulk. The heifers on steamed food not only consumed a greater weight of fresh turnips, in the ratio of 37 to 25; but after allowing for the loss of steaming, they consumed more of the steamed turnips. Thus, after deducting $\frac{1}{5}$ from 37 cwt. 16 lb.—the weight lost in steaming them—the balance 29 cwt. 2 qr. 17 lb. is more than the 25 cwt. 1 qr. 14 lb. of raw turnips consumed by 4 cwt. 1 qr. 3 lb. All the cattle, both on the steamed and raw food, relished salt; so much so, that when it was withheld, they would not eat their food with the avidity they did when it was returned to them.

(1492.) Steamed food should always be given in a fresh state—that is, new made; for if old, it becomes sour, when cattle will scarcely touch it, and the sourer it is they dislike it the more. "In short," says Mr Walker, "the quantity they would consume might have been made to agree to the fresh or sour state of the food when presented to them. . . . We are quite aware that, to have done a large quantity at one steaming, would have lessened the expense of coal and labour, and also, by getting sour before being used, saved a great quantity of food; but we are equally well aware, that, by so doing, we never could have fattened our cattle on steamed food."

(1493.) An inspection of the above table will shew, that both heifers and stots increased more in live-weight on steamed than on raw food; the larger profit derived from the raw food arising solely from the extra expense incurred in cooking the food. It appears, however, that a greater increase of tallow is derived from raw food. The results appear nearly alike with heifers and stots of the same age; but if the stots were of a breed possessing less fattening properties than cross-bred heifers,—and Mr Walker does not mention their breed,—then they would seem to acquire greater *weight* than heifers, which I believe is the usual experience. The conclusion come to by Mr Walker is this: "We have no hesitation in saying that, in every respect, the advantage is in favour of feeding with raw food. But it is worthy of remark, that the difference in the consumption of food arises on the turnips alone. We would therefore recommend every person wishing to feed cattle on steamed food, to use potatoes, or any other food that would not lose bulk and weight in the steaming process; as there is no question but, in doing so, they would be brought much nearer to each other in the article of expense of keep. . . . Upon the whole, we freely give it

as our opinion, that steaming food for cattle will never be attended with beneficial results under any circumstances whatever, because it requires a more watchful and vigilant superintendence during the whole process, than can ever be delegated to the common run of servants, to bring the cattle on steamed food even upon a footing of equality, far less a superiority, to those fed on raw food." *

(1494.) One of the stots that had been fed on raw, and another on steamed food, were kept and put to grass. In their external condition, no one was capable of judging of how they had been fed. They were put to excellent grass on the 20th May, and the stot on raw food gained condition until 20th July, when, perhaps, the pasture may have begun to fail. That on steamed food fell off to that time 3 stones live weight. On 20th August, both were put on cut grass, and both improved, especially the one that had been on steamed food, until the 18th October, when both were put on turnips, on which both became alike by the 10th November, relatively to what they were at the beginning of the season; that is, the stot that had been on raw food increased from 108 to 120 stones, and the other from 106 to 118 stones, live-weight.

(1495.) Similar results as to profit were obtained by the experiments of Mr Howden, Lawhead, East Lothian. "To me," he says, "it has been most decidedly shewn, that preparing food in this way [by steaming] is any thing but profitable. Local advantages—such as fuel and water being at hand—may enable some others to steam at less expense; but in such a situation as mine, I am satisfied that there will be an expense of more than 10s. a-head upon cattle incurred by the practice. A single horse-load of coals, carriage included, costs me 10s.; and exactly 6 cart-loads were required and used in preparing the food for cattle, equal to 6s. 8d. each, and probably as much more would not be an over-estimate for the additional labour in the 3 months." A few facts, worthy of attention, have been brought to light by Mr Howden's experiment. It seems that raw potatoes and water will make cattle fat,—a point which has been questioned by some of our best farmers. Potatoes, beans, and oats, taken together, will feed cheaper, in reference to time, than turnips or potatoes separately; and from this fact may be deduced these, namely, that potatoes, when used alone, to pay their expense, would require the beef fed by them to fetch 4d. per lb.; turnips alone, 3½d.; and potatoes and corn together, 3d., and at the same time yielding beef of finer quality. There is a curious fact to be observed in the table given by Mr Howden. Of 6 heifers, 1 in a lot of 3 weighed 1022 lb.; and another, in another lot of 3, weighed also 1022 lb., on 5th March, when both were put up to be experimented on; and on the 5th June following, both were of the same weight, namely, 1176 lb., both shewing exactly an increase of 154 lb.; both being supplied with the same *weight* of food, namely, 140 lb. of turnips, to the one given raw, to the other cooked. This is a remarkable coincidence; but here it ends, and the superiority of cooked food becomes apparent; for the beef of the heifer fed on raw turnips weighed 5 st. 12 lb. and its tallow 5 st. 10 lb.; whereas, the beef of the one fed on steamed turnips weighed 44 st. 4 lb., and its tallow 6 st. 22 lb. How is this to be accounted for? Partly, no doubt, in the cooking of the food; but partly, I should suppose, from the state of the animal indicated by its hide, the thinner one of the heifer fed on steamed turnips weighing 3 st. 10 lb., shewing a greater disposition to fatten—

* Prize Essays of the Highland and Agricultural Society, vol. x. p. 253.

that is, to lay on more rapidly the valuable constituents of beef and tallow—than the thicker hide of the other heifer fed on raw turnips, which weighed 4 st. 4 lb. It is but justice, however, to the raw turnips to mention a fact to which Mr Howden adverts. The turnips appropriated to the experiment were, it seems, stored against a wall, one store having a northern and the other a western aspect; but whether from aspect, or dampness, or other cause, those intended to be eaten *raw* had fermented in the store a while before being observed, and thus, becoming unpalatable, of the 18 tons 15 cwt. stored, about 2½ tons were left unconsumed; so that, in fact, the heifers upon raw turnips did not receive so much food, or in so palatable a state, as those on the steamed. It seems, steaming renders tainted turnips somewhat palatable, while it has a contrary effect on tainted potatoes, the cattle preferring these raw. Turnips require a longer time to steam, and, according to Mr Howden's experience, they lose $\frac{1}{8}$ or $\frac{1}{10}$ more of their weight than potatoes.* You may observe, from the state of the turnips in the store, the injudiciousness of storing them *against a wall*; as I have before observed (1238.).

(1496.) Mr Boswell of Kingcaussie, in Kincardineshire, comes to the same conclusion in regard to the unprofitableness of feeding cattle on cooked food. He says, "It appears that it is not worth the trouble and expense of preparation to feed cattle on boiled or steamed food; as, although there is a saving in food, it is counterbalanced by the cost of fuel and labour, and could only be gone into profitably where food is very high in price and coal very low." His experiments were made on 10 dun Aberdeenshire horned cattle, very like one another, and their food consisted of the Aberdeen yellow bullock-turnips and Perthshire red potatoes. The 5 put on raw food weighed alive 228 stones 11 lb., and the other 5 on cooked food 224 stones 6 lb. imperial. When slaughtered, the butcher considered both beef and tallow "to be perfectly alike." Those fed on raw food cost L.32 : 2 : 1, and those on cooked L.34 : 5 : 10, leaving a balance of expense of L.2 : 3 : 9 in favour of the former. The opinions of feeders of cattle are not alike on all points. Thus, Mr Boswell says, "That the lot on raw consumed much more food than those on steamed," a fact directly the reverse of that stated by Mr Walker in (1486.). "Twice a week, on fixed days," he continues, "both lots got a small quantity of the tops of common heath, which acted in the way of preventing any scouring; in fact, turnip-cattle seem very fond of heather as a condiment." . . . "The dung of the steamed lot was from first to last in the best state, without the least appearance of purging, and was free of that abominable smell which is observed when cattle are fed on raw potatoes, or even when a portion of their food consists of that article. Another fact was observed, that after the steamed lot had taken to their food, they had their allowance finished sooner than the raw lot, and were therefore sooner able to lie down and ruminate." There is a curious fact mentioned by Mr Boswell regarding a preference and dislike shewn by cattle for turnips in different states. "When *raw* turnips and potatoes were put into the stall at the same time, the potatoes were always eaten up before a turnip was tasted; while, on the other hand, steamed turnips were eaten in preference to steamed potatoes." †

(1497.) Some curious and interesting facts have been arrived at by Mr Ste-

* Prize Essays of the Highland and Agricultural Society, vol. x. p. 266.

† Ibid. vol. x. p. 271.

phenson, Whitelaw, East Lothian, in his experience of feeding cattle. They are detailed by him in a paper on feeding different lots of cattle, not with cooked and raw food, but with different sorts of food in a raw state. He divided a number of cattle into 3 lots, containing 6 in each lot, and fed one on oil-cake, bruised beans, and bruised oats, in addition to whatever quantity of turnips they could eat, and potatoes for the last few days of the experiment; another lot received the same sort of food, with the exception of the oil-cake; and the third lot was fed entirely on turnips. The live-weights of the lots varied considerably from 486 to 346½ imperial stones. I need not detail the particulars of the experiment, which was conducted from November 1834 to March 1835, for 17 weeks, as they present nothing remarkable; but their results are worthy of your attention.

(1498.) Each beast in the lot that got oil-cake cost, in 17 weeks, L.5 : 2 : 7, or 6s. per week; in the lot fed on corn, L.3, 17s., or 4s. 6d. per week; and in that fed entirely on turnips, L.1 : 18 : 7¼, or 2s. 3d. a week. Estimating the value of the fed beef at 6s. 6d. per imperial stone, there was a *loss* of 12⅓ per cent. sustained on the lot fed on oil-cake; a *gain* of 8½ per cent. on that fed on corn; and a *gain* of 22 per cent. on that fed entirely on turnips.

(1499.) This was the cost incurred for producing every 1 lb. of increase of live-weight, the lot fed on oil-cake increasing from 486 to 594 stones; that on corn from 443 to 544 stones; and that on turnips from 346½ to 395½ stones.

The oil-cake cost	$4\frac{9}{10}$	pence to produce 1 lb. of live-weight.			
corn ...	$3\frac{9}{10}$	...	...	...	...
turnips ...	$4\frac{4}{10}$	...	...	...	...

It thus appears, that the joint agency of corn and turnips produces 1 lb. of live-weight at the cheapest rate of the three modes adopted.

(1500.) Another conclusion come to from the data supplied by this experiment is, that it took—

90 lb. of turnips	to produce 1 lb. of live-weight.		
40 lb. of potatoes	...	...	...
$8\frac{7}{10}$ lb. of corn	...	...	...
$21\frac{8}{10}$ lb. of oil-cake	...	...	...

And the cost of doing this was as follows :—

90 lb. of turnips, at 4d. per cwt., . .	$3\frac{2}{10}$d.	per 1 lb.	of live-weight.
40 lb. of potatoes, at 1s. 6d. per cwt., . .	$6\frac{4}{10}$	...	...
$8\frac{7}{10}$ lb. of corn at 3s. 3d. per bushel of 60 lb.	$5\frac{7}{10}$	...	...
$21\frac{8}{10}$ lb. of oil-cake, at ¾d. per lb. or L.7 per ton,	$16\frac{5}{10}$	...	...

Could these results be proved to be *absolutely* correct, there would be no difficulty of assigning the degree of profit to be derived from employing any of these substances in the feeding of cattle. Is not the inquiry, however, of as much importance, even in a national point of view, as to deserve investigation at some sacrifice of both cost and trouble?

(1501.) You should not suppose that cattle consume food of any sort in a uniform ratio; for see actual results. The lot that was fed entirely on turnips increased the first 32 days of the experiment only 8 stones, whereas the same

beasts, in 46 days immediately preceding those on which the experiment began, increased 48½ stones; and in one 8 days of the 46 they consumed 160$\frac{8}{10}$ lb. each of white globe turnips every day, and increased 1 lb. of live weight for every 65$\frac{4}{10}$ lb. of turnips consumed. The 90 lb. taken above as the quantity of turnips required to produce 1 lb. of live weight is therefore not absolute, but assumed as a medium quantity, for it will happen that 1000 lb. will not produce 1 lb. of live weight. What the circumstances are which regulate the tendencies of cattle to fatten, are yet unknown. The fact is, cattle consume very different quantities of turnips in different states of condition, consuming more when lean, in proportion to their weight, than when fat. A lean beast will eat twice, or perhaps thrice, as many turnips as a fat one, and will devour as much as ¼ part of his own weight every day, while a very fat one will not consume $\frac{1}{10}$. I had a striking example of this one year, when I bought a very lean 2-year-old steer, a cross betwixt a short-horn bull and Angus cow, for L.6 in April; and he was a large-boned thriving creature, but his bones were cutting the skin. He was immediately put on Swedish turnips; and the few weeks he was on them, before being turned to grass, he could hardly be satisfied, eating three times as much as the fat beasts in the same hammel. He was grazed in summer, and fed off on turnips and sold in April following for 17 guineas. Some stots of Mr Stephenson's, in November, eat 2$\frac{7}{10}$ lb. for every stone of live weight they weighed; the year after the quantity decreased to 1$\frac{9}{10}$ lb., and after the experiment was included, when their live weights were nearly doubled, they consumed only 1$\frac{5}{10}$ lb.

(1502.) The object which Mr Stephenson had in conducting the experiment the results of which are narrated above, were four-fold:—1. To compare cattle fed partly on oil-cake with those which had none; 2. To compare those fed partly on corn with those which had none; and 3. To compare those fed solely on turnips with those which had different sorts of food. The results were, that oil-cake is an unprofitable food for cattle, that corn yields a small profit, that turnips are profitable, and that when potatoes can be sold at 1s. 6d. per cwt. they are also unprofitable. "When any other food than turnips," observes Mr Stephenson, "is desired for feeding cattle, we would recommend bruised beans, as being the most efficient and least expensive; on this account we would prefer bruised beans alone to distillery offal. As regards linseed cake, or even potatoes, they are not to be compared to beans." . . . "We give it as our opinion, that whoever feeds cattle on *turnips alone* will have no reason, on the score of *profit*, to regret their not having employed more expensive auxiliaries to hasten the fattening process. This opinion has not been rashly adopted, but has been confirmed by a more extended and varied experience in the feeding of cattle than has fallen to the lot of most men." 4. Another object he had in these experiments was, to ascertain whether the opinion is correct or otherwise, that cattle consume food in proportion to their weights. On this subject Mr Stephenson says "that cattle consume food something nearly in proportion to their weights, we have very little doubt, *provided they have previously been fed in the same manner, and are nearly alike in condition.* Age, sex, and kind have little influence in this respect, as the quantity of food consumed depends much on the length of time the beast has been fed, and the degree of maturity the animal has arrived at,—hence the great difficulty of selecting animals to be experimented upon. To explain our meaning by an example, we would say that 2 cattle

of the same weight, and which had been previously kept for a considerable time on similar food, would consume about the same quantity. But, on the contrary, should 2 beasts of the same weight be taken, the one fat and the other lean, the lean beast would perhaps eat twice, or perhaps thrice, as much as the fat one; more especially if the fat one had been for some time previously fed on the same food, as cattle eat gradually less food until they arrive at maturity, when they become stationary in their appetite." . . . "We shall conclude," he says, "by relating a singular fact," and a remarkable one it is, and worth remembering, "that *sheep* on turnips will consume nearly in proportion to *cattle*, weight for weight, that is, 10 sheep of 14 lb. a-quarter, or 40 stones in all, will eat nearly the same quantity of turnips as an ox of 40 stones; but turn the ox to grass, and 6 sheep will be found to consume an equal quantity. This great difference may perhaps," says Mr Stephenson, and I think truly, "be accounted for by the practice of sheep cropping the grass much closer and oftener than cattle, and which, of course, prevents its growing so rapidly with them as with cattle." *

(1503.) Still another question remains to be considered in reference to the feeding of cattle in winter, which is, whether they thrive best in *hammels* or in *byres at the stake?* The determination of this question would settle the future construction of steadings; for, of course, if more profit were certainly yielded to the farmer to feed his cattle in hammels than in byres, not only would no more byres be erected, but those in use converted into hammels; and this circumstance would so materially change the form of steadings, as to throw open the confined courts, embraced within quadrangles, to the influence of the sun, at the only season these receptacles are required, namely, in winter. Some facts have already been decided regarding the comparative effects of hammels and byres upon cattle. Cattle are much cleaner in their persons in hammels than in byres. No doubt they *can* be kept clean in byres, but not being so, there must be some difficulty incidental to byre-management, and it consists, I presume, in the cattle-man finding it more laborious to keep the beasts clean in a byre, than in hammels; otherwise, the fact is not easily to be accounted for, for he takes no *special* care to keep beasts in hammels clean. Perhaps when cattle have liberty to lie down where they please they may choose the driest, because the most comfortable spot: whereas, in a byre, they must lie down upon what they cannot see behind them. There is another advantage derived from hammels; the hair of cattle never scalds off the skin, and never becomes short and smooth, but remains long and mossy, and all licked over, and washed clean by rain, until it is naturally *cast* in spring, and this advantage is felt by cattle when sent to market in winter, where they can withstand much more wet and cold than those which have been fed in byres. A third advantage is, that cattle from hammels can travel the road without injury to their feet, being accustomed to be so much upon their feet, and to move about. It has been alleged in favour of byres, that they accommodate more cattle on the same space of ground, and are less expensive to erect at first than hammels. That in a given space more beasts are accommodated in byres there is no doubt, and there is as little doubt that more beasts are put in a byre than should be: but I have great doubts that it will cost more money to accommodate a given number of cattle in the hammel than in the

* Prize Essays of the Highland and Agricultural Society, vol. xii. p. 61.

byre system; because hammels can be constructed in a temporary form of wood and straw, and make beasts very comfortable, at a moderate charge, whereas byres cannot be formed in that fashion; and even in the more costly form of roofs and walls, the shedding of hammels requires, comparatively to a byre, but a small stretch of roof; and it is well known that it is the roof and not the bare masonry of the walls that constitute the most costly part of a steading. I have seen a set of hammels, having stone and lime walls, and feeding troughs, and a temporary roof, erected for L.1 for every beast it could accommodate, and no form of byre could be built at that cost. But all these advantages of hammels would be of trifling import, if it can be proved by experience that cattle afford larger profits on being fed in byres; and unless this superiority is established in regard to either, the other is undeserving of preference. How, then, stands the fact? has experiment ever tried the comparative effects of both on any thing like fair terms? Mr Boswell of Balmuto, in Fifeshire, and of Kingcausie, in Kincardineshire, has done it; and it shall now be my duty to make you acquainted with the results.

(1504.) To give as much variety to this experiment as the circumstances would admit, it was conducted both at Balmuto and Kingcausie, and the beasts selected for it were of different ages, namely, 2 and 3-year-olds. At Balmuto 4 three-year-olds were put in close byres, and 4 in open hammels, and the same number of 2-year-olds were accommodated in a similar manner at Kingcausie. Those at Kingcausie received turnips only, and of course straw; at Balmuto a few potatoes were given at the end of the season, in addition to the turnips. The season of experiment extended from 17th October 1834 to 19th February 1835. The results were these:—

	St.	lb.	St.	lb.
The 4 hammel-fed 2-year-olds at Kingcausie gained of live weight			45	8
... 4 ... ... 3-year-olds at Balmuto			45	0
			91	8
... 4 byre-fed 2-year-olds at Kingcausie gained of live weight, . .	32	7		
... 4 ... 3-year-olds at Balmuto	36	0		
			68	7
Gain of live weight by the hammel-fed, . . .			23	1

This is, however, not all gain, for the hammel-fed consumed more turnips, the Aberdeen yellow bullock, than the byre-fed.

	Ton.	cwt.	qr.	lb.
Those at Kingcausie consumed more by . . .	1	7	2	6
And those at Balmuto	2	4	3	22
Total more consumed,	3	12	2	0

In a pecuniary point of view, the gain upon the hammel-fed was this:— 23 stones 1 lb. live weight, = $13\frac{3}{4}$ stones beef, at 6s. per stone, gives L.4, 2s., from which deduct the value of the turnips, at 4d. per cwt., L.1 : 4 : 2, leaving a balance of L.2 : 7 : 10.

(1505.) It is a prevalent opinion amongst farmers, that young cattle do not

lay on weight so fast as old. But this experiment contradicts it; for the 2-year-olds in the hammels at Kingcausie gained 44 stone 22 lb. on their united weights of 320 stones 7 lb., in the same time that the 3-year-olds in the hammels at Balmuto, weighing together 350 stones, were of gaining 46 stones. Besides, the young beasts in the hammels at Kingcausie gained over those in the byre 12 stones 15 lb., while the older cattle in the hammels at Balmuto gained over those in the byre only 10 stones. So that, in either way, the young cattle had the advantage over the older.

(1506.) Mr Boswell observes, that "hammels ought never to be used unless when the climate is good, and the accommodation of courts dry and well sheltered; and, above all, unless when there is a very large quantity of litter to keep the cattle constantly clean and dry." Shelter is essential for all sorts of stock in any situation, and the more exposed the general condition of the farm is, the more *need* there is of shelter; but be the situation what it may, it is, in my opinion, quite possible to render any hammel sheltered enough for stock, not only by the distribution of planting, but by temporary erections against its weather-side; and these means will be the more effectual when the hammel is placed facing the meridian sun, which it should be in every case. If these particulars are attended to, and a rain-water spout placed along the eave in front to prevent the rain from the roof falling into the court, and an open drain, with convenient gratings, connected with all the courts, is properly made, the quantity of straw required will not be inordinate, as I have myself experienced when farming dry turnip-soil. Mr Boswell's testimony in favour of hammels is most satisfactory: it is this.—"From the result of my own experiment, as well as the unanimous opinion of every agriculturist with whom I have conversed on the subject, I feel convinced that there is no point more clearly established than that cattle improve quicker, or, in other words, *thrive better in open hammels* than in close byres." *

(1507.) I have dwelt the longer on the subject of feeding cattle, because of its great importance to the farmer, and because of the uncertainty sometimes attending its practice to a profitable issue; and there is no doubt, that whether it leaves a profit or not depends entirely on the mode in which it is prosecuted. Many are content to fatten their cattle in any way, or because others do so, provided they know they are not actually losing money by it, but if they do not make their cattle in the ripest state they are capable of being made, they are, in fact, losing part of their value. But how are they, you may ask, best to be made ripe? There lies the difficulty of the case, and it must be attended with much difficulty before a man of the extensive experience in fattening cattle as Mr Stephenson, would express himself in these words: "We have had great experience in feeding stock, and have conducted *numbers of experiments* on that subject with all possible care, both in weighing the cattle alive, and the whole food administered to them, and in every experiment we made *we discovered something new.* But we have seen enough to convince us, that were *the art of feeding better understood, a great deal more beef and mutton might be produced from the same quantity of food* than is generally done." So far should such a declaration deter you from fattening cattle, it should rather be a proof of the wideness of the field that is still open for you to experiment in.

(1508.) There are but few *diseases* incidental to cattle in a state of confinement in winter, these being chiefly confined to the skin, such as the affection of

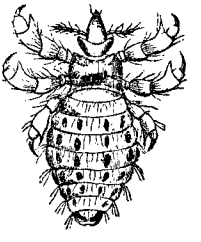
* Prize Essays of the Highland and Agricultural Society, vol. xi. p. 461.

lice, and to accidents in the administration of food, as *hoven* and *obstruction of the gullet* may be termed.

(1509.) *Lice.* When it is known that almost every species of quadruped found in the country, and in a state of nature, is inhabited by one or more pediculidæ, sometimes peculiar to one kind of animal, at other times ranging over many, it will not excite surprise that they should also occur on our domestic ox. Indeed, domestication and the consequences it entails, such as confinement, transition from a low to a higher condition, high feeding, and an occasional deviation from a strictly natural kind of food, seem peculiarly favourable to the increase of these parasites. Their occurrence is well known to the breeder of cattle, and to the feeder of fat cattle; and they are not unfrequently a source of no small annoyance to him. Unless when they prevail to a great extent, they are probably not the cause of any positive evil to the animal, but, as their attacks are attended with loss of hair, an unhealthy appearance of the skin, and their presence is always more or less unsightly, and a source of personal annoyance to cattle, they may much impair the animal's look, which, when it is designed to be exhibited in the market, is a matter of no small consequence. As an acquaintance with the appearance and habits of these creatures must precede the discovery and application of any judicious method of removing or destroying them, I shall describe the species now which are most common and noxious to the ox, and afterwards to the other domestic animals of the farm. They may be divided into two sections, according to a peculiarity of structure, which determines the mode in which they attack an animal, namely, those provided with a mouth formed for sucking, and such as have a mouth with two jaws formed for gnawing. Of the former there are 3 species, which are very common, attacking the ox, the sow, and the ass.

(1510.) *Ox-louse* (*Hæmatopinus surysternus*), fig. 268. It is about 1 or 1½ lines in length, as seen by the line below the figure, the head somewhat triangular, and of a chestnut colour, the eyes pale brown, antennæ pale ochre-yellow, thorax darker chestnut than the head, with a spiracle or breathing-hole on each side, and a deep furrow on each side anteriorly; the shape nearly square, the anterior line concave, abdomen broadly ovate, greyish-white, or very slightly tinged with yellow, with 4 longitudinous rows of dusky horny excrescences, with 2 black curved marks on the last segment; legs long and strong, particularly the 2 fore pairs, the colour chesnut; claws strong and black. This may be called the common louse that infests cattle. It is most apt to abound on them when tied to the stall for winter feeding; and a notion prevails in England that its increase is owing to the cattle feeding on straw. The fact probably is, that it becomes more plentiful when the animal is tied up, in consequence of its being then less able to rub and lick itself, and the creature is left to propagate, which it does with great rapidity, comparatively undisturbed. It generally concontrates its forces on the mane and shoulders. As the parasite is suctorial, if it is at all the means of causing the hair to fall off, it can only be by depriving it of the juices by which it is nourished, which we can conceive to be the case when the sucker is inserted at the root of the hair; but it is more probable that the hair is rubbed off by the cattle themselves, or is shorn off by another louse to

Fig. 268.



I

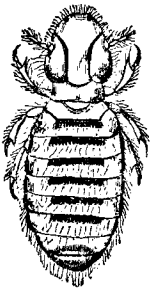
THE OX-LOUSE, HÆMATOPINUS SURYSTERNUS.

be just noticed. The egg or nit is pear-shaped, and may be seen attached to the hairs.

(1511.) *Ox-louse* (*Trichodectes scalaris*), fig. 269.—This parasite is minute, the length seldom exceeding ½ a line. The head and thorax are of a light rust colour, the former of a somewhat obcordate shape, with two dusky spots in front; the third joint of the antennæ longest, and spindle-shaped (in the horse-louse, *Trichodectes equi*, that joint is clavate); abdomen pale, tawny, pubescent, the first 6 segments with a transverse dusky or rust-coloured stripe on the upper half, a narrow stripe of the same colour along each side, and a large spot at the hinder extremity; legs, pale tawny. Plentiful on cattle; commonly found about the mane, forehead, and rump, near the tail-head. It is provided with strong mandibles, with 2 teeth at the apex, and by means of these it cuts the hairs near the roots with facility. Both these vermin are destroyed by the same means as the sheep-louse (1375).

Fig. 269.

I



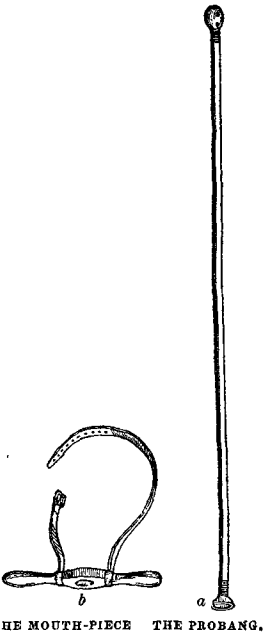
THE OX-LOUSE, TRICHODECTES SCALARIS.

(1512.) *Choking.*—When cattle are feeding on turnips or potatoes, it occasionally happens that a piece larger than will enter the gullet easily, is attempted to be swallowed, and obstructed in its passage. The accident chiefly occurs to cattle receiving a limited supply of turnips, and young beasts are more subject to it than old. When a number of young beasts in the same court only get a specified quantity of turnips or potatoes once or twice a day, each becomes apprehensive, when the food is distributed, that it will not get its own share, and therefore eats what it can with much apparent greediness, and not taking sufficient time to masticate, swallows its food hastily. A large piece of turnip, or a small potato, thus easily escapes beyond the power of the tongue, and, assisted as it is by the saliva, is sent to the top of the gullet, where it remains. Cattle that project their mouths forward in eating, are most liable to choke. When turnips are sliced and potatoes broken, there is less danger of the accident occurring even amongst young cattle. The site of the obstruction, its consequent effects, and remedial measures for its removal, are thus described by Professor Dick. "The obstruction usually occurs at the bottom of the pharynx and commencement of the gullet, not far from the lower part of the larynx, which we have seen mistaken for the foreign body. The accident is much more serious in ruminating animals than in others, as it immediately induces a suspension of that necessary process, and of indigestion, followed by a fermentation of the food, the evolution of gases, and all those frightful symptoms which will be noticed under the disease *hoven*. The difficulty in breathing, and the general uneasiness of the animal, usually direct at once to the nature of the accident, which examination brings under the cognizance of the eye and hand. *No time must be lost in endeavouring to afford relief;* and the *first* thing to be tried is, by gentle friction and pressure of the hand upwards and downwards, to see and rid the animal of the morsel. *Failing in this*, we mention first the great virtue we have frequently found in the use of mild lubricating fluids, such as warm water and oil, well boiled gruel, &c. The gruel is grateful to the animal, which frequently tries to gulp it, and often succeeds. Whether this is owing to the lubrication of the parts, or to the natural action superinduced, it is unnecessary to inquire; but the fact we know, that a few pints of warm gruel have often proved successful in removing the obstruction.

If this remedy should be ineffectual, the foreign body may perhaps be within the reach of the small hand which a kind dairy-maid may skilfully lend for the purpose. *If this good service cannot be procured*, the common probang must be used, the cup-end being employed. Other and more complicated instruments have been invented, acting upon various principles,—some, for example, on that of bruising the obstructing body; and the use of these requires considerable skill. *Disappointed in all*, we must finally have recourse to the knife."* You may try all these remedies, with the exception of the knife, with perfect confidence. The friction, the gruel, the hand, and the probang, I have successfully tried; but the use of the knife should be left to the practical skill of the veterinary surgeon.

(1513.) The common *probang* is represented in fig. 271, *a* being the cup-end, which is so formed that it may partially lay hold of the piece of turnip or potato, and not slip between it and the gullet, to the risk of rupturing the latter, and being of larger diameter than the usual state of the gullet, on pressing it forward distends the gullet, and makes room for the obstructing body to proceed to the stomach. Formerly the probang was covered with cane, but is now with leather, which is more pliable. It is used in this manner. Let the piece of wood, fig. 270, be placed over the opened mouth of the animal as a bit, and the straps of leather attached to it buckled tightly over the neck behind the horns, to keep the bit steady in its place. The use of the bit is, not only to keep the mouth open without trouble, but to prevent the animal injuring the probang with its teeth, and it offers the most direct passage for the probang towards the throat. Let a few men seize the animal on both sides by the horns or otherways, and let its mouth be held projecting forward in an easy position, but no fingers introduced into the nostrils to obstruct the breathing of the animal, nor the tongue forcibly pulled at the side of the mouth. Introduce now the cup-end *a* of the probang, fig. 271, through the round hole *b* of the mouth-piece, fig. 270, and push it gently towards the throat until you feel the piece of the turnip obstructing you; push then with a firm and persevering hand, cautioning the men, previous to the push, to hold on firmly, for the passage of the instrument may give the animal a little pain, and cause it to wince and even start away. The obstruction will now most likely give way, especially if the operation has been performed before the parts around it began to swell; but if not, the probang must be used with still more force, whilst another person rubs with his hands up and down upon the distended throat of the beast. If these attempts fail, recourse must be had to the knife, and a veterinary surgeon sent for instantly.

Fig. 270. Fig. 271.



THE MOUTH-PIECE FOR THE PROBANG. THE PROBANG.

* Dick's Manual of Veterinary Science, p. 46.

(1514.) *Hoven.*—The hoven in cattle is the corresponding disease to the gripes or batts in horses. The direct cause of the symptoms are undue accumulation of gases in the paunch or large stomach, which, not finding a ready vent, causes great pain and uneasiness to the animal, and, if not removed in time, rupture the paunch and death ensues. The cause of accumulation of the gases is indigestion. "The structure of the digestive organs of cattle," says Professor Dick, "renders them peculiarly liable to the complaint, whilst the sudden changes to which they are exposed in feeding prove exciting causes. Thus, it is often witnessed in animals removed from confinement and winter feeding to the luxuriance of the clover field; and in house-fed cattle, from the exhibition of rich food, such as pease-meal and beans, often supplied to enrich their milk. We have already mentioned that it sometimes proceeds from obstructed gullet. The symptoms bear so close a resemblance, both in their progress and termination in rupture and death, to those so fully described above, that we shall not repeat them. The treatment mostly corresponds, and it must be equally prompt. The mixture of the oils of linseed and turpentine is nearly a specific."* The recipe is, linseed-oil, raw, 1 lb.; oil of turpentine, form 2 to 3 oz.; laudanum, from 1 to 2 oz., for one dose. Or hartshorn, from ½ to 1 oz., in 2 pints imperial of tepid water. In cases of pressing urgency, from 1 to 2 oz. of tar may be added to ½ pint of spirits, and given diluted, with great prospect of advantage. These medicines are particularly effective in the early stage of the disease, and should therefore be tried on the first discovery of the animal being affected with it. Should they not give immediate relief, the probang may be introduced into the stomach, and be the means of conveying away the gas as fast as it is generated; and I have seen it successful when the complaint was produced both by potatoes and clover; but I never saw an instance of hoven from turnips, except from obstruction of the gullet. The trial of the probang is useful to shew whether the complaint arises from obstruction or otherwise, for should it pass easily down the throat, and the complaint continue, of course the case is a decided one of hoven. Placing an instrument, such as in fig. 270, across the mouth, to keep it open, is an American cure which is said never to have failed. But the gas may be generated so rapidly that neither medicines nor the probang may be able to prevent or convey away, in which case the apparently desperate remedy of *paunching* must be had recourse to. "The place for puncturing the paunch," directs Professor Dick, "is on the left side, in the central point between the lateral processes of the lumbar vertebra, the spine of the ileum, and the last rib. Here the *trochar* may be introduced without fear. If air escape rapidly, all is well. The canula may remain in for a day or two, and, on withdrawal, little or no inconvenience will usually manifest itself. If no gas escapes, we must enlarge the opening freely, till the hand can be introduced into the paunch, and its contents removed, as we have sometimes seen, in prodigious quantities. This done, we should close the wound in the divided paunch with 2 or 3 stitches of fine catgut, and carefully approximate and retain the sides of the external wound, and with rest, wait for a cure, which is often as complete as it is speedy."† To strengthen your confidence in the performance of this operation, I may quote a medical authority on its safe effects, in the human subject, even to the extent of exposing the intestines as they lay in the abdomen. "I should expect,

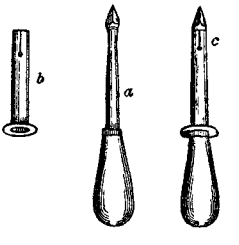
* Dick's Manual of Veterinary Science, p. 54.

† Ibid, p. 54–5.

no immediately dangerous effects from opening the abdominal cavity. Dr Blundell has stated, that he has never, in his experiments upon the rabbit, observed any marked collapse when the peritoneum was laid open, although in full expectation of it. The great danger to be apprehended is from inflammation, and the surgeon, of course, will do all in his power to guard against it."* I once used the trochar with success in the case of a Skibo stot which had been put on potatoes from turnips, and as he was in very high condition, took a little blood from him, and he recovered very rapidly, In another year I lost a fine 1-year-old short-horn quey by hoven, occasioned by potatoes. Oil and turpentine were used, but as the complaint had remained too long, before it was noticed by myself, late at night, the medicine had no effect. The probang went down easily, proving there was no obstruction. The trochar was then thrust in, but soon proved ineffectual, and as I had not the courage to use the knife to enlarge the opening the trochar had made, and withdraw the contents of the paunch with the hand, the animal sank, and was immediately slaughtered. The remedies cannot be too soon applied in the case of hoven.

(1515.) The *trochar* is represented in fig. 272. It consists of a round rod of iron *a*, 5 inches in length, terminating at one end in a triangular pyramidal-shaped point, and furnished with a wooden handle at the other. The rod is sheathed in a cylindrical cover or case *b*, called the canula, which is open at one end, permitting its point to project, and furnished at the other with a broad circular flange. The canula is kept tight on the rod by means of a slit at its end nearest the point of the rod, which, being somewhat larger in diameter than its own body, expands the slit end of the canula until it meets the body, when the slit collapses to its ordinary size, and the canula is kept secure behind the enlarged point as at *c*. On using the trochar, in the state as seen by *c*, it is forced with a thrust, into the place pointed out above, through the skin into the paunch; and on withdrawing the rod by its handle,—which is easily done, notwithstanding the contrivance to keep it on,—the canula is left in the opening, to permit the gas to escape through its channel. On account of the distended state of the skin, the trochar may rebound from the thrust; and in such an event, a considerable force must be used to penetrate the skin.

Fig. 272.



THE TROCHAR.

(1516.) The *fardlebound* of cattle and sheep is nothing more than a modification of the disease in horses called stomach-staggers, which is caused by an enormous distension of the stomach. "In this variety, it has been ascertained," says Professor Dick, "that the *maniplies* are most involved, its secretions are suspended, and its contents become dry, hard, and caked into one solid mass. Though the constipation is great, yet there is sometimes the appearance of a slight purging, which may deceive the practitioner." † The remedial measures are, first, to relieve the stomach by large drenches of warm water, by the use of the stomach pump. Searching and stimulating laxatives are then given, assisted by clysters, and then cordials.

* Stephens on Obstructed and Inflamed Hernia, p. 183-4,

† Dick's Manual of Veterinary Science, p. 57.

(1517.) *Warts* and *angle-berries* are not uncommon excrescences upon cattle. They are chiefly confined to the groin and belly. I have frequently removed them by ligature with waxed silk thread. Escharotics have great efficacy in removing them; such as alum, bluestone, corrosive sublimate.

(1518.) *Encysted tumours* sometimes appear on cattle, and may be removed by simple incision, having no decided root or adhesion. I had a 2-year-old short-horn quey that had a large one upon the front of a hind foot, immediately above the coronet, which was removed by simple incision by a veterinary surgeon. What the true cause of its appearance may have been, I cannot say; but the quey, when a calf, was seen to kick a straw-rack violently with the foot affected, and was lame in consequence for a few days; after which, a small swelling made its appearance upon the place, which, gradually enlarging, became the loose and unsightly tumour which was removed.

(1519.) A grey-coloured scabby eruption, vulgarly called the *ticker*, sometimes comes out on young cattle on the naked skin around the eye-lids, and upon the nose between and above the nostrils. It is considered a sign of thriving, and no doubt it makes its appearance most likely on beasts that are improving from a low state of condition. It may be removed by a few applications of sulphur ointment.

(1520.) In winter, when cows are heavy in calf, some are troubled with a complaint commonly called a *coming down of the calf-bed.* A part of the womb is seen to protrude through the vaginal passage when the cow lies down, and disappears when she stands up again. It is supposed to originate after a very severe labour. Bandages have been recommended, but, in the case of the cow, they would be troublesome, and indeed are unnecessary; for if the litter is made firm and higher at the back than the front part of the stall, so as the hind-quarter of the cow shall be higher than the fore when lying, the protrusion will not occur. I had a cow that was troubled with this inconvenience every year, and as she had no case of severe labour in my possession, I did not know whether, in her case, it was occasioned by such a circumstance; but it seemed to give her no uneasiness, when the above preventive remedy was resorted to.

(1521.) It not unfrequently happens to cattle in large courts, and more especially to those in the court nearest the corn-barn, that an oat-chaff gets into one of their eyes in a windy day. An irritation immediately takes place, causing copious watering from the eye, and, if the chaff is not removed, a considerable inflammation and consequent pain soon ensue, depriving the sufferer of the desire for food. To have it removed, let the animal be firmly held by a number of men, and as beasts are particularly jealous of having any thing done to their eyes, a young beast even will require a number of men to hold it fast. The fore-finger should then be gently introduced under the eye-lid, pushed in as far as it can go, and being moved round along the surface of the eye-ball, is brought round to its original position, and then carefully withdrawn, and examined, to see if the chaff has been removed along with it, which it most likely will be; but if not, repeated attempts will succeed. A thin handkerchief around the finger will secure the extraction at the first attempt. Fine salt or snuff have been recommended to be blown into the eye when so affected, that the consequent increased discharge of tears may float away the irritating substance; but the assistance of the finger is less painful to the animal, and sooner over, and, as it is an operation I have frequently performed with undeviating success, I can attest its efficacy and safety.

35. OF DRIVING AND SLAUGHTERING CATTLE.

" Frisk, dance, and leap, like full-fed beasts, and even
Turn up their wanton heels against the heaven;
Not understanding that this pleasant life
Serves but to fit them for the butchers' knife."

FLAVEL.

(1522.) It is requisite that cattle which have been disposed of to the dealer or butcher, or are intended to be driven to market, should undergo a preparation for the journey. If they were immediately put to the road to travel, from feeding on grass or turnips, when their bowels are full of indigested vegetable matter, a scouring might ensue, which would render them unfit to pursue their journey; and this complaint is the more likely to be brought on, from the strong propensity which cattle have to take violent exercise on feeling themselves at liberty from a long confinement. They, in fact, become *light-headed* whenever they leave the hammel or byre, so much so, that they actually "frisk, dance, and leap," and their antics would be highly amusing, were it not for the apprehension they may hurt themselves against some opposing object; as they seem to regard nothing before them. I remember seeing a dodded Angus stot let out of a byre running so recklessly about, that at length he came at full speed with his head against the wall of the steading, and was instantly felled to the ground. Before any one could run to his assistance, he sprang upon his feet and made off again at full speed, holding his head high, and tail on end, as if he felt proud of having done a feat which no one else could imitate. With distended nostrils and heaving flanks he appeared dreadfully excited; but on being put into his byre, he soon calmed down. On being let out for the first time, cattle should be put a while into a large court, or on a road well fenced with enclosures, and guarded by men, to romp about. Two or three times of such liberty will make them quiet; and in the meantime, to lighten their weight of carcass, they should get hay for a large proportion of their food. These precautions are absolutely necessary for cattle confined in byres, otherwise accidents may befal them on the road, where they will at once break loose. Even at home, serious accidents sometimes overtake them, such as the breaking down of a horn, casting off a hoof, spraining a tendon, bruising ribs, and heating the whole body violently; and, of course, when any such ill-luck befals, the animal

affected must be left behind, and becomes a drawback upon the value of the rest, unless kept on for some time longer.

(1523.) Having been prepared for the road, the *drover*,—who may be your own shepherd, or a hired professional drover,—takes the road very slowly for the first two days, not exceeding 7 or 8 miles a-day. At night, in winter, they should be put into an open court, and supplied with hay and water, and a very few turnips; for if the turnips are suddenly withdrawn from them, their bellies will become what is termed *clinged*, that is, shrunk up into smaller dimensions,—a state very much against a favourable appearance in a market. After the first two days, they may proceed faster, say 12 or 13 miles a-day, if very fat, and 15, if moderately so. When the journey is long, and the beasts get faint in travel, they should get corn to support them. In frosty weather, when the roads become very hard, they are apt to become *shoulder-shaken*, an effect of founder; and if sleet falls during the day, and becomes frozen upon them at night, they may become so chilled as to refuse food, and shrink rapidly away. I had a lot of 12 Angus oxen so affected, on their road to Glasgow, when overtaken in an unexpected storm in May, that I could scarcely recognise them in the market. Cattle should, if possible, arrive the day before in the neighbourhood of a distant market, and be supplied with a good feed of turnips and hay, or grass, to make them look fresh and fill them up again; but if the fair is only a short distance, they can travel to it early in the morning.

(1524.) In driving cattle, the drover should have *no dog*, which will only annoy them. He should walk either before or behind, as he sees them disposed to proceed too fast, or loiter on the road; and in passing carriages, the leading ox, after a little experience, will make way for the rest. In other respects, their management on the road is much the same as that of sheep, though the rate of travelling is quicker. Accommodation will be found at night at stated distances along the road. On putting oxen in a ferry-boat, the shipping of the first one only is attended with much trouble. A man on each side should take hold of a horn, or of a halter made of any piece of rope, should the beast be hornless, and other two men, one on each side, should push him up behind with a piece of rope held between them as a breaching, and conduct him along the plank into the boat, which, if it have low gunwales, a man will require to remain beside him until one or two more of the cattle follow their companion, which they will most readily do. In neglecting this precaution in small ferry-boats, I have seen the first beast leap into the water, and then it was difficult to prevent some of the rest doing the same thing from the quay.

(1525.) Whatever time a lot of cattle may take to go to a market, they should never be *overdriven.* There is great difference in management in this respect amongst drovers. Some like to proceed on the road quietly, slowly, but surely, and to enter the market in a placid cool state. Others, again, drive smartly along for some distance, and rest to cool a while, when the beasts will probably get chilled, and have a staring coat when they enter the market. Whilst others like to enter the market with their beasts in an excited state, imagining them then to look gay; but distended nostrils, loose bowels, and reeking bodies, the ordinary consequences of excitement, are no recommendations to a purchaser. Good judges are shy of purchasing cattle in a heated state, because they do not know how long they may have been in it, and, to cover any risk, will give L.1 a-head below what they would have bid for them in a cool state. Some drovers have a habit of thumping at the hindmost beast of the lot with his stick, while on the road. This is a reprehensible practice, as the flesh, where thumped, will bear a red mark after the animal has been slaughtered, the mark getting the appropriate name of *blood-burn,* and the flesh so affected will not take on salt, and is apt to putrefy. A touch upon the shank, or any tendonous part, when correction is *necessary,* is all that is required; but the voice, in most cases, will answer as well. The flesh of overdriven cattle, when slaughtered, never becomes properly firm, and their tallow has a soft melted appearance.

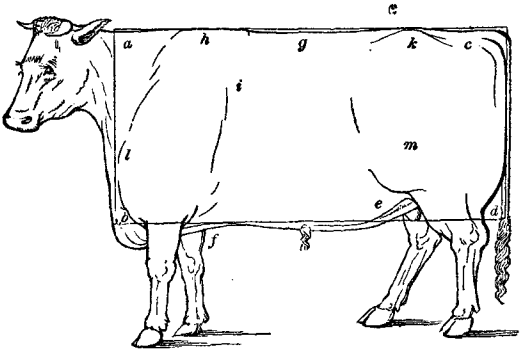
(1526.) A few large oxen in a lot look best in a market on a position rather above the eye of the spectator. When a large lot is nearly alike in size and appearance, they look best and most *level* on a flat piece of ground. Very large fat oxen never look better than on ground on the same level with the spectator. An ox, to look well, should hold his head in a line with the body, with lively ears, clear eye, dewy nose, a well-licked hide, and stand firmly on the ground on all his feet. These are all symptoms of high health and good condition. Whenever you see an ox shifting his standing from one foot to another, he is *foot-sore,* and has been far driven. When you observe him hanging his head and his eyes watering, he feels ill at ease inwardly. When his coat stares, he has been overheated some time, and got a subsequent *chill.* All these latter symptoms will be much aggravated in cattle that have been fed in a byre. You may discover when a beast has been fed at the stake with the seal or baikie, by observing a fretted and callous mark on the *top* of the neck, immediately behind the ears; by the hoofs being rather overgrown at the points; by marks of dung, or at least much resting, upon the outside of the hams; and very frequently by the remains of lice

upon the tail-head and top of shoulder, their scurf remaining, or the hair shorn off altogether.

(1527.) In all *customs relating to markets*, it is the same with cattle as with sheep (1386.). And an ox puts on fat precisely in the same manner as a sheep (1388.).

(1528.) In *judging* cattle, the procedure is somewhat different from that of sheep, inasmuch as the hair of cattle not hiding their form so effectually as wool does that of the sheep, the *eye* is more used than the hand; indeed, in the case of ripe fed cattle, the eye alone is consulted. The hand, as well as the eye, is brought into use in judging of *lean* cattle to lay on to grass or to fatten on turnips; and when we come to consider that matter in Summer and Autumn, I shall let you know the use of the hand in determining the qualities essential to a good *lean* beast. Meantime, our business is with *fat* beasts; and although judging them by the eye is not a difficult thing in itself, it is rather difficult to describe in words. With the assistance, however, of the accompanying figures, I hope you will obtain some useful hints towards acquiring a knowledge of the art. When you look at the *near* side of a *ripe* ox in profile—and this is the side usually chosen to begin with—whatever be its *size*, imagine its body to be embraced within a rectangled parallelogram, as in fig. 273;

Fig. 273.

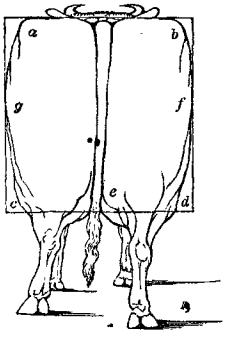


THE SIDE VIEW OF A WELL FILLED-UP FAT OX.

and if the ox is filled up in all points, his carcass will occupy the parallelogram *a b c d* as fully as in the figure; but, in most cases, there will be deficiencies in various parts,—not that *all* the deficiencies will occur in the same animal, but different ones in different animals. The flank *e*, for instance, may be shrunk up, and leave a space there to the line; or the brisket *f* may descend much farther down than is represented; or the rump *c* may be elevated much above the line of the back; or the middle

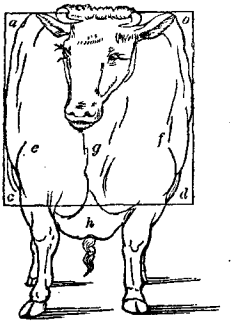
of the back *g* may be much hollowed below the line; or the top of the shoulder *h* may be much elevated above it; or a large space may be left unfilled in the hams above *d*. Then a similar survey should be made behind the animal; the imaginary line should inscribe it also within the perimeter of a rectangled parallelogram, though of different form from the other, as represented in fig. 274, where the breadth of the hook-bones, *a* and *b*, is maintained as low as the points *c* and *d*; and the *closing* between the legs at *e* is also well filled up. This figure gives a somewhat exaggerated view of the appearance of a fat ox behind; but still, it gives the form of the *outline* which it should have. Then go in front of the ox, and there imagine the outline of the body at the shoulder,

Fig. 274.



THE HIND VIEW OF A WELL FILLED-UP FAT OX.

Fig. 275.



THE FRONT VIEW OF A WELL FILLED-UP FAT OX.

inscribed within a rectangled parallelogram *a b c d*, fig. 275, of exactly the same dimensions as the one in fig. 274. The shoulder, from *a* to *b*, is apparently of the same breadth as across the hook-bones, from *a* to *b*, fig. 274. The off-side of the animal may of course be expected to be similar in outline to the near side. Having thus obtained an idea of the outline which a fat ox should have, let us now attend to the filling up of the area of the parallelogram.

(1529.) On looking again at the near-side view, fig. 273, observe whether the ribs below and on each side of *g* are rounded, and nearly fill up the space between the more projecting points *h* and *k*, that is, between the shoulders and the hook. Observe also whether the shoulder *h* is flat, somewhat in the same plane as *g*, or more rounded and prominent; and whether the space behind the shoulder, at *i*, is hollow or filled up. Observe, again, whether the shoulder-point *l* is projecting and sharp, or rounded off; and whether the neck, between *a* and *l*, is flat and sunk, or sweeps finely in with the shoulder. Observe yet more, whether the muscles at *m* are thin and flat, or full and rounded; and

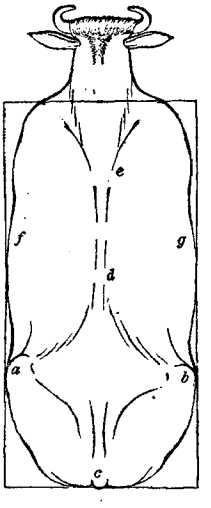
whether the hook-bone *k* projects or sinks in, or appears to connect itself easily with the rump *c* on the one hand, and with the ribs *g* on the other. With all these alternative particulars before you, they should be arranged in the following manner, to constitute *points* in perfection.

(1530.) The line from the shoulder to the hook, from *h* to *k*, fig. 273, should be parallel to the back bone. The space on each side of *g*, along the ribs from *g* to *h*, and along the loin from *g* to *k*, does not fall in with the line *h* and *k*, but should be a little nearer, and almost as high as the back bone, with a rounding fall of the ribs down the side of the animal. The loin, from *k* to *g*, should be perfectly flat above, on the same level as the back bone, and drop down on this side, in connection with the utmost rounding of the ribs. The point of the hook *k* should just be seen to project, and no more; and the space between it and the rump *c* should gradually sweep round to the narrower breadth of the pelvis, as seen from *a* to *c* or *b* to *c* in fig. 276. *i* is placed at the utmost bend of the ribs, along which a straight line should touch every point through *i*, from the front of the shoulder to the buttock. The triangular space comprehended within *a h l* should gradually taper from the shoulder-point to the head. A straight line from *l*, the shoulder-point, should touch every spot from it to *m*. The line of the back should be straight from *a* to *c*; the tail should drop perpendicularly from *c* to *d*; and the belly should sweep level, not high at *e* nor drooping at *f*. There are thus three straight lines along the side of a fat ox, from *a* to *c*, one through *i*, and from *l* to *m*. Proceeding behind the animal to fig. 274, the space between the hooks, from *a* to *b*, should be level, but a little rounded off at both ends, and the bone at the top of the tail only being allowed to project a *little* upwards. The muscles on each side below the hooks, at *g* and *f*, when fuller than the hooks, is no *deformity*, but should they be no fuller, they are right. The muscles at *c* and *d*, down the side of the hams, are allowed to sweep gradually towards the hock joints of the legs. The *closing* at *e* should be well filled up to furnish the rounds fully, but freely, for *packed* rounds prevent easy motion of the hind legs. Sometimes the tail is hid in a channel left by the muscles between *e* and *f*, but this is not usually the case. On going to the front view, fig. 275, the shoulder-top between *a* and *b* should be filled out with a natural round, and the muscles below it upon the shoulder-blades should always project farther than the breadth of the shoulder-top, and in this respect the fore-quarter differs from the hind, where the muscles below the hooks seldom project beyond them. The shoulder points *e* and *f* should not be prominent, but round off with the muscles of the neck towards *g*, where the round of the front of the neck falls from the head to

the breast, where the upper part of the brisket *h* meets it, and projecting a little in front, is rounded below and forms the lowest part of the body of a fat ox, and should be well filled out in breadth to spread the fore legs asunder. The fore legs are usually farther apart than the hind, but the hind at times, when the *shaw* or *cod* is large and fat, is as much and even more apart.

(1531.) The objectionable deviations from these points are as follows: In fig. 273, a hollow back at *g* is bad, shewing weakness of the back bone. A high shoulder-crest at *h* is always attended with a sharp thin shoulder, and has the effect of bringing the shoulder-top *a* and *b*, fig. 275, too close together. A long distance between *g* and *k* makes the loins hollow, and gives to a beast what is called a *washy* appearance, and is always attended with a liability to looseness in the bowels. This washiness is generally attended with an inordinate breadth of hooks, from *a* to *b*, fig. 274, and causes them to project much beyond the muscles below. A sharp projecting hook is always accompanied with flat ribs at *g*, fig. 273, and ribs when flat give the animal a hollow side, which bears little flesh, the viscera being thrown down into the cavity of the belly, which droops considerably below the line; but in the event of the muscles of the abdomen having a greater weight to bear, they become thicker and stronger, and, accordingly, the flesh there becomes less valuable, and it has also the effect of thinning away the thick flank *e*. Flatness of rib is also indicative of hollowness of the space behind the shoulder, so much so, indeed, that the animal seems as if it had been gripped in too firmly there. As the flesh is taken away from the shoulder-blade by a sharp shoulder and hollow ribs, so the shoulder-joint *l* projects the more, and causes a thinness of the neck between *a* and *l*. The rump-bone, at *c*, frequently rises upwards, thereby spoiling the fine straight line of the back; and whenever this happens, the rump between *k* and *c* wants flesh and even becomes hollow, thereby much deteriorating the value of the hind-quarter. A projecting hook *k* also thins away the muscles about *m*, and behind it to the rounds; and this again is followed by an enlargement of the opening at the closing *e*, fig. 274.

Fig. 276.



THE BACK VIEW OF A WELL FILLED FAT OX.

Whenever the shoulder becomes thin and narrow, when viewed in front, as in fig. 275, the shoulder-points *e* and *f* are wider than from *a* to *b*, and while this effect is produced above, the brisket *h* below

becomes less fat, and permits the fore legs to stand nearer each other. A greatly commendatory point of a fat ox is a level broad back from rump to shoulder, because all the flesh seen from this position, as is endeavoured to be represented by fig. 276, is of the most valuable description; where the triangular space included between *a*, *b*, *c*, is the rump; the triangular space between *a*, *b*, *d*, the loin; and the space between *d* and *e*, deflecting on both sides towards *f* and *g*, the ribs, the value of all which parts are enhanced the more nearly they all are on a level with each other. All that I have endeavoured to describe, in these three paragraphs, of the points of a fat ox, can be judged of alone by the eye, and most judges never think of employing any other means; but the assistance derived from the hand is important, and in a beginner cannot be dispensed with.

(1532.) The first point usually *handled* is the end of the rump at the tail head, at *c*, fig. 273, although any fat here is very obvious, and sometimes attains to an enormous size, amounting even to deformity. The hook-bone *k* gets a touch, and when well covered, is right; but should the bone be easily distinguished, the rump between *k* and *c* and the loin from *k* to *g* may be suspected, and, on handling these places, the probability is that they will both be hard, and deficient of flesh. To the hand, or rather to the points of the fingers of the right hand, when laid upon the ribs *g*, the flesh should feel soft and thick and the form be round when all is right, but if the ribs are flat the flesh will feel hard and thin, from want of fat. The skin, too, on a rounded rib, will feel soft and mobile, the hair deep and mossy, both indicative of a kindly disposition to lay on flesh. The hand then grasps the flank *e*, and finds it thick, when the existence of internal tallow is indicated. The cod is also fat and large, and on looking at it from behind seems to force the hind legs more asunder than they would naturally be. The palm of the hand laid along the line of the back from *c* to *h* will point out any objectionable hard piece on it, but if all is soft and pleasant, then the shoulder-top is good. A hollowness behind the shoulder at *i* is a very common occurrence; but when it is filled up with a layer of fat, the flesh of all the fore quarter is thereby rendered very much more valuable. You would scarcely believe that such a difference could exist in the flesh between a lean and fat shoulder. A high narrow shoulder is frequently attended with a ridged back bone, and low-set narrow hooks, a form which gets the appropriate name of *razor-back*, with which will always be found a deficiency of flesh in all the upper part of the animal, where the best flesh always is. If the shoulder-point *l* is covered, and feels soft like the point of the hook-bone, it is good, and indicates a well-filled neck-

vein, which runs from that point to the side of the head. The shoulder-point, however, is often bare and prominent. When the neck-vein is so firmly filled up as not to permit the points of the fingers into the inside of the shoulder-point, indicates a well tallowed animal; as also does the filling up between the brisket and inside of the fore legs, as well as a full, projecting, well covered brisket in front. When the flesh comes down heavy upon the thighs, making a sort of double thigh, somewhat like the shape at *d* and *e*, fig. 274, it is called *lyary*, and indicates a tendency of the flesh to grow on the lower instead of the upper part of the body. These are all the *points* that require *touching when the hand is used;* and in a high-conditioned ox, they may be gone over very rapidly.

(1533.) Cattle are made to fast before being slaughtered, as well as sheep. The time they should stand depends on the state of the animal on its arrival at the shambles. If it has been driven a considerable distance in a proper manner, the bowels will be in a tolerably empty state, so that 12 hours may suffice; but if full and just off its food, 24 hours will be required. Beasts that have been overdriven, or much struck with sticks, or are in any degree infuriated,—or *raised*, as it is termed,—should not be immediately slaughtered, but allowed to stand on dry food, such as hay, until the symptoms disappear. While such precautions are certainly necessary to preserve meat in the best state, we can scarcely credit the loss there must be incurred every year in Smithfield market in London, by the injuries sustained by the animals being driven through the streets of an immensely peopled metropolis. The state of many of the animals in the market on a Monday morning is truly pitiable. "The loss to the grazier," says a writer, who advocates the removal of the market to the suburbs, "is in the difference in value of his sheep or cattle, when they arrive in the neighbourhood of the metropolis, and when offered for sale in Smithfield after intense suffering from hard blows, driving over the stones, from hunger, thirst, fright, and the compressed state in which they are constrained to be packed; the sheep and beasts the whole time, from their raised temperature, clouding the atmosphere of Smithfield with dense exhalations from their bodies. The London butcher, carrying on a respectable trade, will at all times, when he enters the market, reject such cattle or sheep as are what is termed in a *mess;* that is, depressed, after excitation by being overlaid or overdriven, or such as have been more than usually troublesome in getting into the market, and, consequently, will be in a more worried and exhausted condition. It is to be observed, that all animals brought into Smithfield, especially on the Monday's market-day, are more or less in the condition above described." He goes on to state, that "a calculation has been made, that

512,000 serious and extensive œdematous bruises are, in the course of one year, discovered on cattle after they are slaughtered. The pain these bruises must occasion to the cattle, and the loss to the butcher or the public, is exclusive of those parts of the animal which suffer most from the conduct of the drovers, namely, the head, especially the nasal organs, and concussions of the brain by blows on the horns, besides the more acute suffering from blows on the hocks." The beef consumed in London, in 1836, amounted to 9½ millions of stones, which, at 6s. a stone, gives a total value of L.2,850,000; and if its deterioration is taken only at half-a-farthing per pound, the annual loss sustained by the bruises of cattle alone will amount to L.69,270, 16s.*

(1534.) Cattle are slaughtered in a different manner from sheep, and the mode differs in different countries. In the great abbatoirs at Montmartre, in Paris, they are slaughtered by bisecting the spinal chord of the cervical vertebræ; and this is accomplished by driving a sharp-pointed chisel between the second and third vertebra, with a smart stroke of a mallet, while the animal is standing, when it drops, and death or insensibility instantly ensues, and the blood is let out immediately by opening the bloodvessels of the neck. The plan pursued in this country is, first to bring the ox down on his knees, and place his under-jaw upon the ground, by means of ropes fastened to his head, and passed through an iron ring in the floor of the slaughter-house. He is then stunned with a few blows from an iron axe made for the purpose, on the forehead, the bone of which is usually driven into the brain. The animal then falls on its side, and the blood let out by the neck. Of the two modes, the French is apparently less cruel; for some oxen require many blows to make them fall; I once witnessed an ox receive nine blows before he fell. I have heard it alleged by butchers, that the separation of the spinal chord producing a general nervous convulsion throughout the body, prevents the blood flowing so rapidly and entirely out of it, as when the ox is stunned in the forehead. The skin is then taken off to the knees, when the legs are disjointed, and also off the head. The carcass is then hung up by the tendons of the hough, on a stretcher, by a block and tackle, worked by a small winch, which keeps good what rope it winds up by a wheel and rachet.

(1535.) Every farm on which sheep are killed should have a proper slaughter-house, such as is seen at fig. 1, Plate I. at *y*, the ground-plan of which may be seen in fig. 2, Plate II., where it is represented to be 10 feet by 9 feet, a space too small when cattle are slaughtered, but it

* The Question of the Smithfield Market fully Considered, p. 21–24.

is very rare that an ox is slaughtered on a farm, except when one is so that is likely to be lost by some acute disease, in which contingency the animal is slaughtered in the straw-barn and hung up by the balks; but it is quite easy, when the slaughter-house is fitting up, to have a block and tackle and small winch, erected at a convenient corner, to be used on such occasions. The floor should be laid with clean-droved pavement, and have a decided slope to the side at which the drain is made to take away the dirty water occasioned by cleaning, which it should always be thoroughly. The walls should also be plastered, and a ventilator placed on the roof, to maintain a draught of air. The site chosen for the slaughter-house should be in a cool place, away from the sun's influence in summer, for in a heated apartment meat never becomes firm. A locked closet is useful to hold the knives, steel, and stretchers, and the outer-door provided with a good thumb-latch, and lock and key; the key, of course, always to remain in the farm-house until needed.

(1536.) It is the shepherd's duty to act the part of butcher on a farm. He should learn to slaughter gently, dress the carcass neatly and cleanly, in as plain a manner as possible, without *flourishes*, as the figures incised on the membranous skin are called, and separate the valuable from the worthless portion of the entrails, keeping the loose fat by itself, and hang up the skin in a suitable place to dry. It is his duty also to keep the slaughter-house neat and clean.

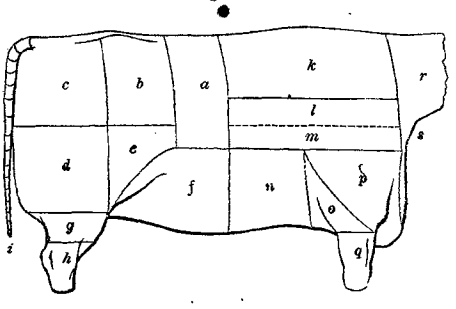
(1537.) After the carcass has hung 24 hours, it should be cut down by the back-bone, or chine, into two *sides*. This is done either with the saw or chopper; the saw making the neatest job in the hands of an inexperienced butcher, though it is the most laborious, and with the chopper is the quickest, but by no means the neatest plan, especially in the hands of a careless fellow. In London the chine is equally divided between both sides, while in Scotland one side of a carcass of beef has a great deal more bone than the other, all the spinous processes of the vertebra being left on it. The bony is called the *lying* side of meat. In London the divided processes in the fore quarter are broken in the middle when warm, and chopped back with the flat side of the chopper, and this has the effect of thickening the fore and middle ribs considerably when cut up. The London butcher also cuts the joint above the hind knee, and, by making some incisions with a sharp knife, cuts the tendons there, and drops the flesh of the hind quarter on the flanks and loins, which causes it to cut up thicker than in the Scotch mode. In opening up the hind quarter he also cuts the aitch-bone or pelvis through the centre, which makes the rump look better. Some butchers in the north country score

the fat of the *closing* of the hind quarter, which has the effect of making that part of both heifer and ox look like the udder of an old cow. There is far too much of this scoring practised in Scotland, and ought to be abandoned, and let the pieces have more their natural appearance.

(1538.) In cutting up a carcass of beef the London butcher displays great expertness; he not only discriminates between the qualities of its different parts, but can cut out any piece to gratify the taste of his customers. In this way he makes the best use of the carcass, realizes the largest value for it, while he gratifies the taste of every grade of customers. A figure of the Scotch and English modes of cutting up a carcass of beef will at once shew you their difference, and on being informed where the valuable pieces lie, you will be enabled to judge whether the oxen you are breeding or feeding possess the properties that will enable you to demand the highest price for them.

(1539.) The Scotch mode of cutting up a carcass of beef is repre-

Fig. 277.



THE SCOTCH MODE OF CUTTING UP A CARCASS OF BEEF.

sented in fig. 277, and these are the names of the different pieces of meat:—

In the hind quarter.

a, The sirloin, or back sey.
b, ... hook-bone.
c, ... buttock, } the rump.
d, ... large round, }
e, ... thick flank.
f, ... thin flank.
g, ... small round.
h, ... hough.
i, ... tail.

In the fore quarter.

k, The spare rib, or fore sey.
l, ... runner, } large and small.
m, ... runner, }
n, ... nineholes.
o, ... brisket.
p, ... shoulder-lyar.
q, ... nap or shin.
r, ... neck.
s, ... sticking piece.

a the sorloin is the principal roasting piece, making a very handsome dish, and is a universal favourite. It consists of two portions, the Scotch

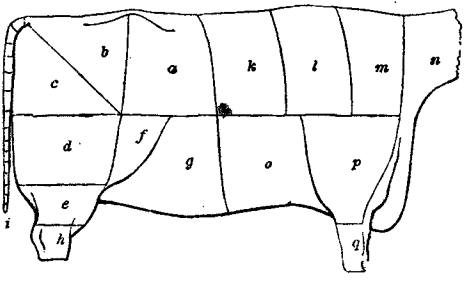
and English sides, the former is the one above the lumbar bones, and is somewhat hard in ill-fed oxen; the latter consists of the muscles under those bones, and are generally covered with fine fat, and are exceedingly tender. The better the beast is fed the larger is the under muscle, better covered with fat, and more tender to eat: *b* the hook-bone and *c* the buttock, are cut up for steaks, beaf-steak pie, or minced collops, and both these, along with the sirloin, fetch the highest price: *d* is the large round, and *e* the small round, both well known as excellent pieces for salting and boiling, and are eaten cold with great relish: *h* the hough is peculiarly suited for boiling down for soup, having a large proportion of gelatinous matter. Brown soup is the principal dish made of the hough, but its decoction forms an excellent *stock* for various dishes, and will keep in a state of jelly for a considerable time. The synovial fat, skimmed off in boiling this piece, and poured upon oatmeal, seasoned with pepper and salt, constitutes the famous *fat brose* for which Scotland has long been celebrated. In the making, this brose should not be much stirred, and the oatmeal left amongst the fat gravy in small dry lumps. It was of this piece that the old favourite soup of Scotland, called *skink*, was made. *e* is the thick and *f* the thin flank, both excellent pieces for salting and boiling: *i* is the tail, and insignificant as it may seem, it makes a soup of very fine flavour. Hotel-keepers have a trick of seasoning brown soup, or rather beef-tea, with a few joints of tail, and passing it off for genuine ox-tail soup. These are all the pieces which constitute the hind quarter, and it will be seen that they are valuable both for roasting and boiling, not containing a single coarse piece. In the fore quarter is *k*, the spare rib or fore sey, the six ribs of the back end of which make an excellent roast, and when taken from the side opposite to the *lying* one, being free of the bones of the spine, makes a large one; and it also makes excellent beef-steaks and beef-steak pie. *l* and *m* are the two runners, and *n* the nine-holes, make salting and boiling pieces; but of these, the nineholes is much the best, as it consists of layers of fat and lean without any bone; whereas the fore parts of the runners have a piece of the shoulder-blade in them, and every piece connected with that bone is more or less coarse-grained: *o* the brisket eats very well boiled fresh in broth, and may be corned and eaten with boiled greens or carrots: *p* the shoulder-lyar is a coarse piece, and fit only for boiling fresh to make into broth or beef-tea: *q* the nap or shin, is analogous to the hough of the hind leg, but not so rich and fine, there being much less gelatine in it: *r* the neck makes good broth, and the sticking-piece *s* is a great favourite with some epicures, on account of the pieces of rich

fat in it. It makes an excellent stew, as also sweet barley broth, and the meat eats well when boiled in it. These are all the pieces of the fore quarter, and it will be seen that they consist chiefly of boiling pieces, and some of them none of the finest, the roasting piece being confined to the six ribs of the spare-rib *k*, and the finest boiling piece, corned, only to be found in the nineholes *n*.

(1540.) In some of the largest towns of Scotland, a difference of 1d. per lb. may be made between the roasting and boiling pieces, but in most towns, and in the country villages, all the pieces realize the same prices, and even the houghs and shins fetch 3d. per lb.

(1541.) In the English mode the pieces are cut up somewhat differ-

Fig. 278.



THE ENGLISH MODE OF CUTTING UP A CARCASS OF BEEF.

ently, especially in the fore quarter. Fig. 278 shews this mode, and it consists of the following pieces:—

In the hind quarter.	In the fore quarter.
a, The loin.	*k*, The fore rib.
b, ... rump.	*l*, ... middle rib.
c, ... aitch-bone.	*m*, ... chuck rib.
d, ... buttock.	*n*, ... clod, and sticking, and neck.
e, ... hock.	*o*, ... brisket.
f, ... thick flank.	*p*, ... leg-of-mutton piece.
g, ... thin flank.	*q*, ... shin.
h, ... shin.	
i, ... tail.	

a the loin is the principal roasting piece; *b* the rump, is the favourite steak-piece; *c* the aitch-bone, the favourite stew; *d* the buttock, *f* the thick flank, and *g* the thin flank, are all excellent boiling pieces when corned; *e* the hock, and *h* the shin, make soup, and afford *stock* for various purposes in the culinary art; and *i* is the tail for ox-tail soup —a favourite English luncheon. In the curious case of assessing da-

mages against the Bank of England for removing the famous Cock eating-house in Threadneedle Street, it was produced in evidence, that, in the 3 years 1837–8–9, there had been 13,359 ox-tails used for soup; and as 36 tails make 10 gallons of soup, there had been served up 59,360 basins, at 11d. the basin, making the large amount of L.2720 : 13 : 4 for this article alone.* These are all the pieces in the hind quarter, and it will be seen they are valuable of their respective kinds. In the fore quarter, *k* the fore rib, *l* middle rib, and *m* chuck-rib, are all roasting pieces, not alike good; but in removing the part of the shoulder-blade in the middle rib, the spare ribs below make a good broil or roast; *n* the neck makes soup, being used fresh, boiled, and the back end of the brisket *o* is boiled corned, or stewed; *p*, the leg-of-mutton piece, is coarse, but is as frequently stewed as boiled; *q* the shin is put to the same uses as the shin and hock of the hind quarter. On comparing the two modes of cutting up, it will be observed that, in the English there are more roasting pieces than in the Scotch, a large proportion of the fore quarter being used in that way. The plan, too, of cutting the line between *b* and *c*, the rump and aitch-bone in the hind quarter, lays open the steak-pieces to better advantage than in the Scotch buttock *c*, fig. 277. Extending the comparison from one part of the carcass to the other, in both methods, it will be seen that the most valuable pieces—the roasting—occupy its upper, and the less valuable—the boiling—its lower part. Every beast, therefore, that lays on beef more upon the upper parts of its body, is more valuable than one that lays the same quantity of flesh on its lower parts.

(1542.) The relative values of the pieces differ much more in London than in Scotland. The rumps, loin, and fore-ribs fetch the highest price; then come the thick flank, buttock, and middle-rib; then the aitch-bone, thin flank, chuck-rib, brisket, and leg-of-mutton piece; then the clod, sticking, and neck; and last of all the legs and shins. In actual pecuniary value, the last may bear a proportion of only one-fourth of the highest price.

(1543.) Of the qualities of beef obtained from different breeds of cattle, I believe there is no better meat than from the West Highland breed for fineness of grain, and cutting up into convenient pieces for family use. The Galloways and Angus, when fattened in the English pastures, are great favourites in the London market. The Short-horns afford excellent steaks, being thick of flesh, and the slice deep, large, and juicy, and their corned flanks and nineholes are always thick, juicy, and

* John Bull, 16th January 1841.

well mixed. The Herefords are somewhat similar to the Short-horns, and the Devons may perhaps be classed among the Galloways and Angus; whilst the Welsh cannot be compared to the West Highland. So that, taking the breeds of Scotland as suppliers of good beef, they seem to be more valuable for the table than those of England. Any beef that I have seen of Irish beasts is inferior, but the cattle derived from Britain, fed on the pastures of Ireland, afford excellent meat. Shetland beef is the finest grained of all, but the pieces are very small.

(1544.) In regard to the proportion of beef and tallow generally obtained from cattle, Dr Cleland states, that of 14,566 head of cattle sold in the Glasgow market in 1822, averaging exactly 44 stones imperial, each yielded 5½ stones, which is exactly ⅛ of the weight of beef.* From 4 of the oxen experimented on by Mr Stephenson, and which were slaughtered at the same time, these results were obtained:—

Cattle.	Live weight.	Beef.		Tallow.		Hide.		Other offals.	
No.	St.	St.	lb.	St.	lb.	St.	lb.	St.	lb.
1.	112	66	2	8	10	5	11	32	5
2.	100	58	6	7	7	4	12	29	3
3.	108	62	3	9	0	4	12	26	13
4.	109	62	4	9	4	5	12	31	8

The proportion of tallow to beef is here nearer ⅐ than ⅛ over the whole beasts; and there is another result worth attending to, which is that of Nos. 2 and 3, which had the same weight of hide, namely, 4 st. 12 lb.; No. 3 must have had the finest skin and touch, for its superiority in every respect is apparent, both in weight of tallow, which was 9 st. to 7 st. 7 lb.; in weight of beef, which was as 62 st. 3 lb. to 58 st. 6 lb.; and in lightness of other offals, which were as 26 st. 13 lb. is to 29 st. 3 lb. Besides difference in quality of the same weight of hide, a lighter hide, under similar circumstances, will produce the same results as those above. For example. Of two of the heifers fed by Mr Howden on raw and steamed food, which afforded the same live weight when put up to feed, namely, 1022 lb., and the same live weight after the experiment was concluded, namely, 1176 lb., one had a light hide, that is, 52 lb. weight, and the other a heavier one, 60 lb., and the light one was accompanied with 620 lb. of beef and 96 lb. of tallow, while the heavier hide was associated with only 572 lb. of beef and 80 lb. of tallow. All these proportions very nearly indicate the tallow at ⅐ of the beef; but sometimes the proportion of tallow is very much greater and much less. I had a young Short-horn cow which slipped her second calf, and was fed when she became dry, which was in November, and in May following was sold to the late Mr Robert Small, flesher, Dundee, when she yielded 72½ stones of beef and 27 stones of tallow, being in the ratio of 2⅔ : 1. On the other hand, Lord Kintore's large ox that was exhibited at the Highland and Agricultural Society's Show at Aberdeen in 1834, only yielded 16 st. 7 lb. of tallow, from

* Cleland's Account of the Highland and Agricultural Show at Glasgow in 1828, p. 40.

173 st. 4 lb. of beef; being in the ratio of $10\frac{1}{2} : 1$.* There are perhaps not sufficient data in existence to determine the true proportion of offal of all kinds to the beef of any given fat ox; but approximations have been made which may serve the purpose until the matter is investigated by direct experiment, under various circumstances. The dead weight bears to the live weight a ratio varying between .571 and .605 to 1; and on applying one or other multiple to the cases of the live weight, you will find a pretty correct approximation. The tallow is supposed to be $\frac{8}{100}$ of the live weight, so that the multiple is the decimal of .08. The hide is supposed to be $\frac{5}{100}$ of the live weight, so to obtain its weight, a multiple of .05 should be used. The other offals are supposed to bear a ratio of about $\frac{1}{4}$ of the live weight, so that the multiple of .28 is as near as can be proposed under existing experience.†

(1545.) *Beef* is the staple animal food of this country, and it is used in various states,—fresh, salted, smoked, roasted, and boiled. When intended to be eaten fresh, " the *ribs* will keep the best, and with care will keep 5 or 6 days in summer, and in winter 10 days. The middle of the *loin* is the next best, and the *rump* the next. The *round* will not keep long, unless salted. The *brisket* is the worst, and will not keep longer than 3 days in summer, and a week in winter."‡ In cooking, a piece of beef, consisting of four of the largest ribs, and weighing 11 lb. 1 oz., was subjected to roasting by Mr Donovan, and it lost during the process 2 lb. 6 oz., of which 10 oz. were fat, and 1 lb. 12 oz. water dissipated by evaporation. On dissection, the bone weighed 16 oz., so that the weight of meat fit for the table was only 7 lb. 11 oz. out of 11 lb. 1 oz. It appears that when the butchers' price of ribs is $8\frac{1}{2}$d. per lb., the cost of the meat when duly roasted is $11\frac{1}{2}$d. per lb., and the average loss arising from liquefaction of fat and evaporation of water is 18 per cent. With sirloins, at the price of $8\frac{1}{2}$d., per lb. the meat cost, when roasted, 1s. $1\frac{1}{6}$d. per lb., at a loss of $20\frac{1}{3}$ per cent. A loss of 18 per cent. was also sustained on boiling salted briskets; and on salted flanks at 6d. per lb. the meat cost $7\frac{3}{4}$d. per lb., at a loss of $13\frac{1}{3}$ per cent.§ In regard to the power of the stomach to digest beef, that which is eaten boiled with salt only is digested in 2 hours 45 minutes. Beef, fresh, lean, and rarely roasted, and a beef-steak broiled, takes 3 hours to digest: that fresh and dry-roasted, and boiled, eaten with mustard, are digested in 3 hours and 30 minutes. Lean fresh beef fried takes 4 hours to digest, and old hard salted beef boiled does not digest in less than 4 hours 15 minutes. Fresh beef-suet boiled takes 5 hours 30 minutes to digest.‖

(1546.) The usual mode of preserving beef is by *salting;* and when intended to keep a long time, such as for the use of shipping, it is always salted with brine; but for family use it should be salted dry with good Liverpool salt, without saltpetre; for brine dispels the juice of the meat, and saltpetre only serves to make the meat dry, and give it a disagreeable and unnatural red colour. Various experiments have been made to cure beef with salt otherwise than by hand-

* Quarterly Journal of Agriculture, vol. vii. p. 499.

† Prize Essays of the Highland and Agricultural Society, vol. xii. p. 65.

‡ The Experienced Butcher, p. 171.

§ Donovan's Domestic Economy, vol. ii.

‖ Combe on Digestion and Dietetics, p. 134–6.

rubbing, and in a short space of time; and also to preserve it from putrefaction by other means than salt. Those of Messrs Payne and Ellmore, of London, consist in putting meat in a copper which is rendered air-tight, and an air-pump then creates a vacuum within it, thereby extracting all the air out of the meat; then brine is pumped in by pressure, which, entering into every pore of the meat formerly occupied by the air, is said to place it in a state of preservation in a few minutes. M. Gannal, of France, preserved the carcass of an ox from putrefaction for 2 years by injecting 4 lb. of a saline mixture into the carotid artery. Whether any such contrivance can be made available for family purposes, seems doubtful. Up to the 10th October 1842, salted beef imported was subject to a duty of 12s. per cwt.; since that date both salted and fresh pay a duty of 8s. per cwt. from foreign countries, and 2s. from British possessions. Up to that period the importation of live-stock was prohibited, by the same act; bulls and oxen can now be imported from foreign countries at L.1 each, and from British possessions, 10s.; cows, 15s. and 7s. 6d.; calves, 10s. and 5s.: sheep, 3s. and 1s. 6d., and lambs, 2s. and 1s. each.* Salted beef cured with wood smoke is converted into a ham, and very highly relished. The tierce of salted beef for the navy contains 300 lb., consisting of 38 pieces of 8 lb. each.

(1547.) Cattle are useful to man in various other ways than affording food from their flesh, their offals of tallow, hides, and horns, forming extensive articles of commerce. Of the *hide*, the characteristics of a good one for strong purposes, is strength in its middle or *butt*, as it is called, and light on the edges or *offal*. A bad hide is the opposite of this, thick in the edges and thin in the middle. A good hide has a firm texture, a bad one loose and soft. A hide improves as the summer advances, and it continues to improve after the new coat of hair in autumn until November or December, when the coat gets rough from the coldness of the season, and the hide is then in its best state. It is surprising how a hide improves in thickness after the cold weather has set in. The sort of food does not seem to affect the quality of the hide; but the better it is, and the better cattle have been fed, and the longer they have been well fed, even from a calf, the better the hide. From what has been said of the effect of weather upon the hide, it seems a natural conclusion that a hide is better from an ox that has been fed in the open air than from one fed in a byre. Dirt adhering to a hide injures it, particularly in byre-fed animals; and any thing that punctures a hide, such as *warbles* arising from certain insects, is also injurious. The best hides are obtained from the West Highland breed of cattle. The Short-horns produce the thinnest hides, the Aberdeenshire the next, and then the Angus. Of the same breed, the ox affords the strongest hide; but as hides are applied to various uses, the cow's hide, provided it be large, may be as valuable as an ox's. The bull's hide is the least valuable. Hides are imported from Russia and South America; and the number imported in 1838 was 301,890. The duty on hides, by the new tariff, is 6d. per cwt. for dried and 3d. for wet.

(1548.) Hides, when deprived of their hair, are converted into leather by infusion of the astringent property of bark. The old plan of tanning used to occupy a long time; but such was the value of the process, that the old tanners used to pride themselves in producing a substantial article. More recent discoveries have prompted tanners to hasten the process, much to the injury of the article produced. Strong infusions of bark make leather brittle; 100 lb. of skin,

* The Act to amend the Laws relating to the Customs, Table A.

quickly tanned in a strong infusion, produce 137 lb. of leather; while a weak infusion produces only 117½, the additional 19½ lb. serving only to deteriorate the leather, and cause it to contain much less textile animal solid. Leather thus highly charged with tannin is so spongy as to allow moisture to pass readily through its pores, to the great discomfort and danger of persons who wear shoes made of it. The proper mode of tanning lasts a year or a year and half, according to the quality of the leather wanted, and the nature of the hides. A perfect leather is recognised by its section, which should have a glistening marbled appearance, without any white streaks in the middle.* Leather is applied to many important purposes, being made into harness for agricultural and other uses. It is used to line the powder magazines of ships of war; to make carding machines for cotton and other mills; belts to drive machinery; to make soles of shoes; and, when japanned, to cover carriages. Calves' leather is used in bookbinding. The duty on tanned hides is now fixed at L.10 per L.100 value. The hair taken off hides in tanning is employed to mix with plaster, and is surreptitiously put into hair-mattresses. The duty imposed on foreign cattle hair is 6d. per cwt.

(1549.) "The principal substances of which *glue* is made," says Dr Ure, are the paring of ox and other thick hides, which form the strongest article; the refuse of the leather-dresser; both afford from 45 to 55 per cent. of glue. The tendons, and many other offals of slaughter-houses, also afford materials, though of an inferior quality, for the purpose. The refuse of tanneries—such as the ears of oxen, calves, sheep, &c.—are better articles; but parings of parchment, old gloves, and in fact animal skins in any form, uncombined with tanning, may be made into glue." †

(1550.) *Ox-tallow* is of great importance in the arts. Candles and soap are made of it, and it enters largely into the dressing of leather and the use of machinery. Large quantities are annually imported from Russia. Of the exports from St Petersburgh, consisting of 4¼ millions of poods, at least 3½ millions are exported to this country, at the value of L.2,306,150, at L.35 per ton.‡ Of the quantity imported in 1837, 1,294,000 cwt. were retained for home consumption. Ox-tallow consists of 76 parts of stearine and 24 of oleine out of the 100. The duty on tallow by the new tariff is 3s. 2d. per cwt. from foreign countries, and 3d. per cwt. from the colonies.

(1551.) The *horns* of oxen and sheep are used for many purposes. "The horn consists of two parts: an outward horny case, and an inward conical-shaped substance, somewhat intermediate between indurated hair and bone," called *the flint* of the horn. "These two parts are separated by means of a blow on a block of wood. The horny exterior is then cut into three portions by means of a frame-saw. The lowest of these, next the root of the horn, after undergoing several processes by which it is rendered flat, is made into combs. The middle of the horn, after being flattened by heat and its transparency improved by oil, is split into thin layers, and forms a substitute for glass in lanterns of the commonest kind. The tip of the horn is used by the makers of knife-handles and of the tops of whips, and for other similar purposes. The interior, or core of the horn, is boiled down in water. A large quantity of fat rises to the surface; this is put

* Ure's Dictionary of the Arts, art. *Leather-Tanning.*

† Ibid., art. *Glue.*

‡ Macculloch's Dictionary of Commerce, art. *Tallow.*

aside, and sold to the makers of yellow soap. The liquid itself is used as a kind of glue, and is purchased by the cloth-dresser for stiffening. The bony substance which remains behind is then sent to the mill, and, being ground down, is sold to the farmers for manure. Besides these various purposes to which the different parts of the horn are applied, the clippings which arise in comb-making are sold to the farmers at about 1s. per bushel. The shavings which form the refuse of the lantern-makers are also sold as manure." * Horn, as is well known, is easily rendered soft and pliant in warm water; and by this, and the property of adhesion like glue, large plates of horn can be made by cementing together the edges of small pieces rendered flat by a peculiar process, as a substitute for glass. For this purpose, the horns of goats and sheep are preferred, being whiter and more transparent than those of any other animal. Imitation of tortoise-shell can be given to horn by the use of various metallic solutions. Horn, also, when softened, can be imprinted with any pattern by means of dies.† The duty on horns is 1s. per ton, and on hoofs L.1 per L.100 value.

---

36. OF THE TREATMENT OF FARM-HORSES IN WINTER.

> " But loose betimes, and through the shallow pond,
> Drive the tired team, and bed them snug and warm;
> And with no stinting hand their toil reward."
>
> GRAHAM.

(1552.) With the exception of a few weeks in summer, farm-horses occupy their stable all the year round. It is situate at O, fig. 3, Plate III., where it is seen with two doors and two windows in front, and surmounted with two ventilators on the roof. Its plan may be seen at O, fig. 4, Plate IV., where it is represented as containing 12 stalls. The fitting up of the stable in all its particulars of stalls, floor, and accommodation, having already been fully dilated on when treating of the steading, from (23.) to (34.), more seems unnecessary to be said in regard to these particulars in this place.

(1553.) Farm-horses are under the immediate charge of the ploughmen, one of whom works a pair, and keeps possession of them generally during the whole period of his engagement. This is a favourable arrangement for the horses, as they work much more steadily under the guidance of the same driver, than when changed into the hands of different; and it is also better for the ploughman himself, as he will per-

* Babbage on the Economy of Machinery and Manufactures, p. 180.

† Ure's Dictionary of the Arts, art. *Horn*.

form his work much more satisfactorily to himself, as well as his employer, with horses familiarized to him than with strange ones. In fact, the man and his horses must become acquainted before they can understand each other; and when the peculiarities of each party are mutually understood, work becomes more easy, and of course greater attention can be bestowed upon it. Some horses shew great attachment to their driver, and will do whatever he desires without hesitation; others shew no particular regard; and the same difference may be remarked of ploughmen towards their horses. Upon the whole, however, there seems to be a very good understanding in this country between the ploughman and his horses; and, indeed, independently of this, I believe there are few masters disposed to allow their horses to be ill treated, because there is no occasion for it; for horses which have been brought up upon a farm, in going through the same routine of work every year, become so well acquainted with what they have to do in every department of work, that should a misunderstanding arise between them and their driver, you may safely conclude that the driver is in the wrong.

(1554.) The treatment which farm horses usually receive in winter is this:—The ploughmen, when single, get up and breakfast before daybreak, and by that time go to the stable, where the first thing they do is to take out the horses to the water. The usual place at which horses drink is at the horse-pond; and should ice prevent them, it must be broken. To horses out of a hot steaming stable, water at the freezing point must be any thing but a palatable beverage; and yet it is not easy to see how a better plan can be devised; for though a drinking trough were provided for them, of the purest water, it would be as liable to freeze as a pond, and to have two pailfuls of water, thawing all night in the stable, for each pair of horses, is an expense which no farmer will incur. The only other plan is to have a cistern within the stable, from which the water could be drawn in pailfuls in the morning; and still this plan would cause some loss of time, in helping every pair of horses with water from the cistern from the same pails; and the cistern would, besides, become useless whenever mild weather returned. Well, then, the horses are taken to the pond to drink, and are again brought back to the stable to receive their morning allowance of corn. From habit, however, the horses do not require to be led out and into the stable to the pond, and all the care they require is, that one of the men see they do not saunter or loiter away their time. While the horses are out of the stable, the rest of the men take the opportunity of cleansing away the dung and soiled litter made during the night, into the

adjoining court-yard K, fig. 3, Plate III., with their shovels (fig. 149.), wheelbarrow, and besoms. While the horses are absent, usually one of the ploughmen supplies each corn-box with corn from the corn-chest, where the steward is ready to deliver him the feed appointed for each horse. Or every man takes his pair of nose-bags, and supplies his own horses before beginning to clean out the stable. Or the steward himself puts corn into every manger, while the men are employed in cleaning the stable. This last plan, if he is provided with a light box beside the corn-measure, to carry two feeds at a time, saves the most time, which, in a short winter's morning, is of some consequence. On the return of the horses to the stable from the water, they find their mangers plenished with corn, and it is scarcely worth while binding them with the stall-collars, if the men remain in the stable and go to work whenever the horses have finished their corn. It is not an unusual practice to put the harness on while the horses are engaged with their corn; but this should by no means be allowed. Let the horses enjoy their food in peace, as many of them, from sanguine temperament or greed, cannot divest themselves of the feeling that they are about to be taken away from their corn, if worked about during the time of feeding. The harness can be quickly enough put on after the feed is eaten, as well as the horses curried and brushed, and the mane and tail combed. A very common practice, however, is to dress the horses while eating, which should not be allowed. A better plan in all respects is, to let the horses eat their corn undisturbed, and then dress and harness them afterwards, and it has the advantage of allowing them a little time between eating their corn and going out to work, which, if of a violent nature, undertaken with a full stomach, may bring on an attack of *batts* or colic. The plan which I have just described is intended to apply to single men who live together, and who have their own victuals to cook; but should the ploughmen be married men, the best arrangement for them is to go to the stable when they rise, water the horses, clean the stable, corn the horses, bind them up, and, shutting the door, leave them in quiet to eat their food, as long as they themselves are in taking their breakfast, which by that time should be made ready by their wives. On returning to the stable after breakfast, the horses should then be dressed, combed, and harnessed, when they will come out quite fresh and clean to go to yoke, and after their feed has been a little time in their stomachs.

(1555.) Men and horses continue at work until 12 noon, when they come home, the horses to get a drink of water and a feed of corn, and the men their dinner. Some keep the harness on the horses during this

short interval, but it should be taken off, to allow both horses and harness to cool, and at any rate the horses will be much more comfortable without it, and it can be taken off and put on again in a few seconds, and besides, the oftener the men are exercised in this way, they will become the more expert. When the work is in a distant field, rather than come home between yokings, it is the practice of some farmers to feed the horses in the field out of the nose-bags; and the men to take their dinners with them, or be carried to them in the field by their own people. This plan may do for a day or two in good weather on a particular occasion; but it is by no means a good one for the horses, for no mode so effectual for giving them a chill could be contrived than to cause them to stand on a head-ridge for nearly an hour in a winter day, after working some hours. A smart walk home can do them no harm, and if time is pressing for the work to be done, let the horses remain a shorter time in the stable. The men themselves will feel infinitely more comfortable to get dinner at home. There is a practice in England connected with this subject, that I think highly objectionable, which is, doing a day's work in one yoking. For a certain time horses, like men, will work with spirit, but if made to work beyond that time, they not only lose strength, but their very spirit is wrung out of them, and in the latter part of the time will do their work in a careless manner. Horses thus kept for 7 or 8 hours upon the stretch at work, must be injured in their constitution, or, if able to withstand it, it must be either at the expense of bad work executed at the latter part of the yoking, or of curtailment of hours of a full day's work, or of extraordinary feeding, either of which expedients is no compensation for bad management. Common sense tells a man that it is much better for a horse to be worked a few hours smartly, and have his hunger satisfied before feeling fatigue, when he will again be able to proceed with fresh vigour, than to be worked the same number of hours without feeding. I can see no possible objection that can be offered to horses receiving a little rest and food in the middle of a long day's work, but I see many and serious ones to their working all day long without rest and food. Suppose, then, that men and horses come home at mid-day, the usual dinner hour of agricultural labourers, the first thing to be done is to give the horses a drink at the pond on the way to the stable; and there should then be no washing of legs. From the water the horses proceed to the stable, where the harness is taken off; and as the men then have nothing else to do, every man gets the corn from the steward at the corn-chest for his own horses in nose-bags, or in a small corn-trough or box which each man keeps for the purpose. Of these two sorts of things for carry-

ing the corn in the stable, I prefer the trough, as being most easily filled and emptied of corn. The horses are bound up, the stable door shut, and the men go to their own houses to dinner, which should be in readiness for them. After dinner they proceed to the stable, when the horses will be found to have finished their feed, and when a small quantity of fodder may be thrown before them fresh from the straw-barn, for at this time of year farm-horses get no hay. The men may have a few minutes to converse until 10 minutes to 1 P.M., when they should give the horses a slight wisp down, put on the harness, comb out their tails and manes, and be all ready to put on the bridles the moment 1 o'clock arrives, which is announced by the steward.

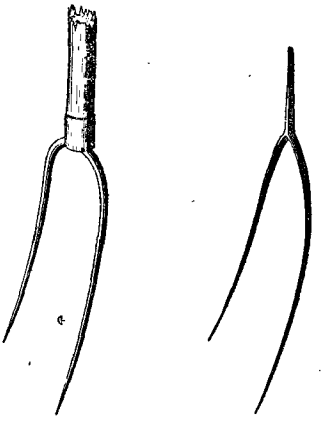
(1556.) The afternoon yoking is short, not lasting longer than sunset, which at this season is before 4 P.M., when the horses are loosened out of yoke, and brought home. After drinking again at the pond, they are gently passed through it, to wash off any mud from their legs and feet, which they can hardly escape collecting in winter. But in washing, the men should be prohibited wetting their horses above the knees, which they are most ready to do, should there be any mud upon the thighs and belly; and to render this prohibition effectual, I have expressly stated, when speaking of the construction of a horse-pond (125.), that it should not be made deeper at any part than will take a horse to the knee. There is danger of contracting inflammation of bowels or colic in washing the bellies of horses in winter; and to treat mares in foal—which they will be at this time of year—in this way, is little short of madness. If the feet and shanks are cleared of mud, that is all that is required in the way of washing in winter. On the horses entering the stable and having their harness taken off, they are well strapped down by the men with a wisp of straw. Usually, two wisps are used, one in each hand; but I am sure the work is much better done with one, shifting the hand as occasion requires, and directing the attention to one place at a time. A couple of wisps may very properly be taken to rub down the legs and clean the pasterns, rendering them as dry as a moderate length of time will admit. All this is done not quite in the dark, for there is still a glimmer of twilight in the western horizon, but too much in the dark to allow its being well done. Farmers either think there is no occasion for light in a stable at this hour, or grudge the expense; but either excuse is no justification of the neglect of so necessary a thing as light in a dark stable. In fact, the steward ought to have a light ready to meet the horses when they enter the stable, and then every thing would be seen to be done in a much more satisfactory manner than they generally are. After the horses are rubbed

down, the men proceed to the straw-barn, and bundle each 4 windlings of fodder-straw, one to be given to each horse just now, and the other two to be put above the stalls across the small fillets *p*, fig. 7, which run along the stable for the purpose. This preparation is made for the same reason that the cattle-man stowed away his windlings for the cows in the byre—that the straw-barn may not be entered with a light. The stable has been without litter all day since its cleansing out in the morning, and the horses have stood on the stones at midday. This is a good plan for purifying the stable during the day, and is not so much attended to as it deserves. Sufficient litter-straw is then brought in by the men from the straw-barn to make the stalls comfortable, should any of the horses desire to lie down. Leaving the horses to their fodder, and shutting the stable-doors, the men retire to whatever occupation they please, until 8 P.M., the hour at which horses receive their suppers.

(1557.) When 8 P.M. arrives, the steward, provided with light in a lantern, summons the men to the stable to give the horses a grooming for the night and their suppers. The sound of a horn, or ringing of a bell, are the usual calls on the occasion, which the men are ready to obey. I may here remark in passing, that the sound of a horn is pleasing in a calm winter night, and I never hear it without its recalling to my mind the goatherds' horns in Switzerland, pouring out their mellow and prayer-like strains at sunset, the time for gathering the flocks together from the mountain sides, on their way to the folds in the neighbouring village. Lights are placed at convenient distances in the stable to let the men see to groom the horses. The grooming consists first in currying the horse with the curry-comb, to free him of all dirt that may have adhered to the skin during the day, and which has now become dry and flies off. A wisping of straw removes the roughest of the dirt loosened by the curry-comb. The legs ought to be thoroughly wisped, not only to make them clean, but dry of any moisture that may have been left in the evening, and at this time the feet should be picked clear by the foot-picker of any dirt adhering around between the shoe and the foot. The brush is then used to remove the remaining and finer portions of dust, from which, in its turn, it is cleared by a few rasps of the curry-comb. The wisping and brushing, if done with some force and dexterity, with a combing of the tail and mane, should render the horse pretty clean; but there are more ways than one of grooming a horse, as may be witnessed by the skimming and careless way in which some ploughmen do it. It is true that the rough coat of a farm horse is not easily cleaned, and more especially in a work-stable where there is much dust floating about and no horse-clothes in use; but rough as it is,

it may be *clean* though not *sleek;* and it is the duty of the steward to see that the grooming is done in an efficient manner. A slap of the hand upon the horse will soon let you know whether there is any loose dust in his hair. Attendance at this time will give you an insight into the manner in which farm-horses ought to be cleaned and generally treated in the stable. The straw of the bedding is then shaken up with a fork such as in fig. 279. This figure has rather longer prongs, and is too sharp for a *stable fork,* which is most handy for shaking up straw when about 5 feet in length, and least dangerous of injuring the legs of the horses by puncture when blunt. The united prongs terminate at their upper end in a sort of spike or tine, which is driven into a hooped ash shaft, as better seen in fig. 280, which is a steel pronged fork of the form used in Lincolnshire, and is an excellent instrument for working amongst straw. This mode of mounting a fork is much better than with socket and nail, which are apt to become loose and catch the straw. The horses then get their feed of oats, after which the lights are removed and the stable doors barred and locked by the steward, who is custodier of the key. In some stables a bed is provided for a lad, that he may be present to relieve any accident or illness that may befal any of the horses; but where the stalls are properly constructed, there is little chance of any horse strangling himself with the collar, or any becoming sick where a proper ventilation is established.

Fig. 279. Fig. 280.



THE COMMON FORK. THE LINCOLNSHIRE STEEL FORK.

(1558.) In winter it is usual to give farm-horses a mash, once at least, and sometimes thrice a week. The mash consists of either steamed potatoes, boiled barley or oats, mixed sometimes with bran, and sometimes seasoned with salt. The articles are prepared in the boiler *b'* in the boiling house U, fig. 4, Plate IV., in the afternoon by the cattle-man or a field-worker, or any other person appointed to do it, and put into tubs, into which it is carried to the stable by the men, and dealt out in the troughs used to carry the corn to the horses, with a shovel. It is warm enough when the hand can bear the heat. The quantity of corn put into the boiler is usually as much as that given raw, and in preparation swells out considerably, so that the mash acquires considerable bulk. The horses are exceedingly fond of mash, and when the night arrives for its being dealt out, shew unequivocal symptoms of impatience until they

receive it. The quantity of raw oats given to farm-horses, when on full feed, is 3 lippies a day, by measure and not by weight; but taking horse-corn at almost the highest figure of 60 lb. per firlot, each feed will weigh 3¾ lb., the daily allowance amounting to 11¼ lb.; but the lippy-measure, when the corn is dealt out, is most frequently not striked, but heaped, or at least hand-waved, so that the full allowance will weigh even more than this. As horses work only 7 or 8 hours a day in winter, their feeding is lessened to perhaps 2 full feeds a day or 7½ lb., divided into three portions, namely, a full feed in the morning, ½ feed at midday, and ½ feed at night; and on the nights the mash is given, the evening ½-feed of oats is saved. Some small farmers withdraw the corn altogether from their horses in the depth of winter, giving them mashes of some sort instead; whilst others only give them one feed a day, divided at morning and noon, and a mash at night, or turnips or potatoes at night. One of the sorts of mash alluded to consists of barley, or oat or wheat chaff, steeped for some hours in cold water in a large tub or cistern made for the purpose, and a little light barley or oats is sometimes put in to give an appearance of corn. But a greater deception than such a mess in lieu of corn cannot be practised upon poor horses;—for what support can be derived from chaff mixed with cold water? As well might the mess be made up at once in the manger. No doubt horses eat it, but only from hunger; and when they are obliged to live upon it, it gives a return of thin ribs, pot-bellies, and long hair, characteristics that bespeak poverty of condition. A neighbour farmer to myself, faithfully as the winter came round, *fed* his horses, as he phrased it, upon this *steep;* and the consequence was, that they went like snails at their work, and when returning home from delivering a load of corn at the market-town, with even the indulgence of an extra half-feed, one leg was always like to drive over the other. A farm-steward recommended this steep to me as effecting a great saving in corn, and shewed me a fine set of cisterns, made of pavement, which he had advised his master, a landed proprietor, to erect for the purpose of making it. Before eulogising the cisterns, I proposed to do any number of days' work of any sort with my horses against his, on their respective modes of feeding, and then it would be ascertained which would be best able to continue at it, as this is the only test by which the qualities of feeding can be tried. He declined the trial, as he had had frequent opportunities of seeing my horses pass his way with single carts, stepping out at 3 miles an hour, with a load out and home. No doubt, the steep is economical, in as far as saving in corn is concerned. But this is not the sole consideration; for if it be not also economical, in as far as to maintain the ability of the horses for

severe labour in spring, it is of no comparative value; and no one, who knows what this steep is, will be disposed to maintain that it does. One season, as a mash, I tried steamed potatoes, with salt alone, of which the horses were excessively fond, and received three times a week, and on which they became very sleek in the skin and fat, notwithstanding much heavy work; but in spring, when the long day field-work was resumed, they seemed to me to be all affected with shortness of wind. Have cooked potatoes necessarily this effect upon horses? I may mention that oats, when desired to be cooked, must be *boiled*, as steaming only burns the outside, and does not penetrate into the interior, having somewhat the effect of kiln-drying. Oats, in fact, and barley too, must be macerated to be cooked, and to do this effectually *warm* water must be used.

(1559.) I have often thought that the usual careless manner of placing the lights in the stable in the evening is highly dangerous to the safety of the building; and yet, in the most crowded and dirty stables, no accidents of fire almost ever happen. Sometimes the candle is stuck against a wall by a bit of its own melted grease; at other times, it hangs by a string from the roof in an open lantern, set apparently on purpose to light straws. A good stable lantern is still a desideratum; and it should be made to hold a candle, and not an oil-lamp, as being the most cleanly mode of light for carrying about; and if the candle could be made to require no snuffing, it would be perfect. A common tin-lantern, with a horn glass, is what is commonly in use to carry the candle in the air; but when it gets blackened with smoke in the inside, it is of little use to give light outside. I have seen a globe lantern of glass made very strong for use on board of ship, but it has an oil lamp. I observe Messrs Palmer and Company, London, advertising a "weather *candle*-lamp for *safety*, and for use in *wind* and *rain*, and which requires *no snuffing*." The candle costs 8½d. per lb., and burns 5 hours for 1d. I have not seen this lamp; but judging from its figure, and if the glass is made strong enough, it would seem to answer the purpose, and is certainly not dear. If safe, it might be taken into the straw-barn, hammels, &c. at night.

(1560.) From the stable the steward takes the lantern, and accompanied by a few of the men, or by all—and of necessity by the cattle-man—inspects all the courts and hammels to see if the cattle are safe; and if it be moonlight, and any of the cattle on foot apparently desirous of more food, a few more turnips should be given them from the stores. The byres in which cattle are feeding are also visited, and the fresh windlings of straw, laid up in reserve by the cattle-man, are now given

them, any dung in the stalls drawn into the gutter, and the bedding shaken up with a fork. The cows, both the farmer's and servants', are visited and treated in like manner. The bulls, heifers in calf, and young horses, all are visited at this time, to satisfy the mind, before retiring to rest, that no harm has happened to any creature.

(1561.) This is the usual routine of the treatment of farm-horses in winter, and when followed with some discernment in regard to the state of the weather, is capable of keeping them in health and condition. The horses are themselves the better of being out every day; but the species of work which they should do daily must be determined by the state of the weather and the soil. In very wet, frosty, or snowy weather, the soil cannot be touched; but then thrashing and carrying corn to market may be conducted to advantage, and the dung from the courts may be taken out to the fields in which it is proposed to make dunghills. This latter piece of work is best done when the ground is frozen hard. When heavy snow falls, nothing can be done out of doors with horses, except thrashing when the machine is impelled with horse-power. In a very rainy day, the horses should not go out, as every thing about them, as well as the men, become soaked: and before both or either can be again made comfortable, the germs of serious disease may be laid in both. When it is fair above, on the other hand, however cold the air or wet the soil, some of the sorts of outdoor work mentioned above may be done by the horses; and it is better for them to work only one yoking a-day, than to stand idle in the stable. Work-horses soon shew symptoms of impatience when confined in the stable even for a day, on Sundays, for example; and when the confinement is much prolonged, they even become troublesome. When such occasions happen, which they do in continued snow-storms, with the ground covered deep, the horses should be ridden out for some time every day, and groomed as carefully as when at work. Exercise is necessary to prevent thickening of the heels, a shot of grease, or a common cold. Fat horses, when unaccustomed to exercise, are liable to molten grease.

(1562.) It is an advisable plan for a farmer to breed his own horses; and, on a farm which employs 6 pairs, two mares might easily bear foals every year, and perform their share of the work at the same time, without injury to themselves. The advantage of breeding working stock at home is, that, having been born and brought up upon the ground, they not only become naturalized to the products of its particular soil, and thrive the better upon them, but also become familiarized with every person and every field upon it, and are broke into work without trouble or risk. The two mares should work together, and be driven by a

steady ploughman; and their work should almost always be confined to ploughing, particularly in winter and spring, when they are big with young, for the shaking in the shafts of a cart is nothing in their favour. In driving home turnips, and leading out dung in winter, over most probably not the smoothest of roads, mares in foal should not be employed, their driver rather ploughing with them, when that operation can be performed, or assisting the other men at their carts with manual labour.

(1563.) There is a good arrangement in regard to the horses adopted by some farmers, and it is well adapted for married ploughmen of different strengths and ages, which is, the keeping a pair or two of the horses always at home, ploughing and doing many other labours of the farm, but never bearing cart-loads upon the highway. Old horses, mares in foal, and ploughmen advancing beyond middle life, may thus be kept at home; and a stated number of the draughts, consisting of the youngest of the horses, and the most active of the men, are appointed to drive and carry all the loads that require to be taken to and from the farm. This sort of subdivision of labour has the advantage of fixing the minds of the men on the respective sorts of work they are best adapted for.

(1564.) Supposing, then, that one or two mares bear foals every year, the young horses, their produce, consisting of foals, year-olds, and two-year-olds, should be accommodated in the steading N, figs. 3 and 4, Plates III. and IV., according to age, where there are more than one of the same age, the older being apt to knock about the younger; but where one only of every age is brought up, they may be placed together for the sake of companionship, as horses are very social animals, and they learn to accommodate themselves to one another's tempers. Where blood foals are bred as well as draught, they should have separate hammels, the latter being too rough and overbearing, but the bloods generally contrive to obtain the mastery. Young horses never receive any grooming, and are even seldom handled; but they should all be accustomed to be led in a halter from their youngest period.

(1565.) The food usually given to young horses in winter is oat-straw for fodder, and a few oats; and where they are wintered among the young cattle in the large court K, they have the chance of a few pickings of corn from the corn-barn, or the refuse of hay from the litter of the work-horse stable, and then they seldom get corn. The fact is, young horses are generally unjustly dealt with; they are too much stinted of nourishing food, and the consequences established by the treatment is a smallness of bone which deprives them of requisite strength for their work, and a dulness of spirits which renders their work a burden to them.

I speak of what I have seen of the way in which a large proportion of the farm-horses of this country are brought up when young. Their treatment seems to be derived from the opinion, that very little nourishing meat should be given to young horses. Instead of this, they should receive a stated allowance of corn,—and if bruised, so much the better,—according to their ages; and when a mash is given to the work-horses, the young ones should always have a share. For the purpose of receiving corn and mash, mangers should be put up in the inside of each hammel, apart from each other. Attempts at domineering will be made by the powerful over the weak; but proper correction administered at times, and justice seen done to all, will put an end to tyranny. The steward cannot be better employed than in attending upon the corning of the young horses; and the cattle-man should attend to their fodder and litter. And were the mash for the horses prepared before daylight goes, the feeds for the young horses could be given immediately after the men leave the stable in the twilight. Should a mash be grudged as being too extravagant for young horses, they should get Swedish turnips or potatoes every day; for some moist food is requisite with dry fodder and corn.

(1566.) The names usually given to the different states of the horse are these:—The new-born young is called a *foal*, a male one being a *colt foal* and a female a *filly foal*. After being weaned, the foals are called *colt* or *filly*, according to the sex, which the male retains until broken in for work, when he is a *gelding* or *horse*, which he retains all his life; and the filly is then changed into *mare*. When the colt is not castrated, he is an *entire colt;* which name he retains until he serves mares, when he is a *stallion* or *entire horse*. A mare, when served, is said to be *covered by* or *stinted to* a particular stallion; and after she has borne a foal, then she is a *brood mare*, until she ceases to bear, when she is a *barren mare* or *eill mare;* and when dry of milk, she is said to be *yeld*. A mare, while bearing a foal, is said to be *in foal*.

(1567.) There are various ways of employing the men in winter, when the horses happen to be laid idle from the state of the weather. Some farmers employ them to dress the corn for the market; and this is done with a view to economy. Ploughmen may certainly be legitimately employed in taking in a stack of corn and thrashing it with the mill, when not engaged with their horses; but to lay horses idle for the sake of employing their drivers at barn-work, is poor economy indeed. Men, generally, cannot riddle corn well, and in every other respect are too rough in their mode of work for the nicer jobs of the barn. In deep snow, when all the roads of the farm are blown up, the men may be

usefully employed in cutting open roads to the most frequented place for the time, such as to the field of turnips, to the field where the sheep are feeding on turnips, to the field in which it is proposed to make a dung-hill. Their services of this sort may even be required on the public highway, when it is determined to cut open a road for the public convenience. In the severe snow-storm of 1823 this had to be done oftener than once, and unless the assistance of farm-servants had been gratuitously proffered upon those occasions, the opening of the roads would have cost much more, and taken a longer time than they did. In such a state of the weather, the men are usefully employed in assisting the shepherd to open channels in the snow, among the stripped turnips, to allow the sheep to get at them, as I mentioned before, when speaking of sheep on turnips (1293.), and in carrying hay for the ewes (1294). In heavy falls of rain, and sudden breaking up of snow-storms, rivulets and ditches often become more full of water than they can conveniently contain, and are therefore apt to overflow the arable ground on each side, to the injury of new wheat, or souring of the ploughed land, as the case may be. It is the duty of the hedger to attend to the state of the ditches, and see that no injury arises from the water in its course through the farm; but the exertions of one man, in such a case, are quite inadequate to stem a torrent, or even a calm determined body of water. The men should therefore all turn out, with suitable implements, and assist in removing any obstruction which the water may have raised against its own course, and to cut gaws, where necessary, for leading water off the sour or ploughed soil. Small rivers, on the breaking up of a season of frost, sometimes bring down shoals of ice, which, on being obstructed at some sharp turn, form a damming, behind which the water accumulates, from whence, perhaps, only finding a vent over the top of an embankment, it overcomes it, and destroys the protected soil with its violence. Where such an incident is likely to occur in the course of a river, a sharp look-out should be kept at every point of danger, at the breaking up of a storm of frost, and men prepared, at a moment's warning, with proper instruments, as poles, long forks, sledge hammers, and mallets, to break, guide, and otherwise destroy the shoals, so as to prevent their accumulation in any one place. A timely preparation of this nature, applied with activity and skill, may be the means of averting damage to a considerable amount. Such occupations as these are quite befitting stout men; and if the steward attends to his duty, he will be on the outlook for every casualty which may reasonably be expected to happen, in the circumstances, and in taking the lead, may enjoy the satisfaction of having been the means, by the exercise of forethought and judgment,

of saving much valuable property. But, besides the zeal of his auxiliaries, the farmer himself should be the first to give warning of the approach of danger, and guide his men in averting it.

(1568.) You have seen, that though cattle gain weight when fed on cooked food, compared to others fed on the same substances in a raw state; yet the expense of cooking counterbalances any advantage gained in weight, and it is therefore inexpedient to undertake the trouble of it. These results might have been anticipated from the peculiar functions of the stomach of the ox; for he *chews the cud*, that is to say, he masticates the food, as he takes it into his mouth in a very imperfect manner, rendering it only so small as to be able to swallow it with some degree of force, in which state it reaches the paunch or first stomach; where, if it decomposes immediately and generates gas, it produces the disease of the *hoven*, which has been spoken of already (1514.). But should it not decompose—which is the usual condition of the food—it is again brought up to the mouth, and undergoes a thorough mastication, after which it is swallowed and finds its way to the stomach, which contains the gastric juice, there to be digested for the purpose of being assimilated into the system. Now, all that we can do for the ox in cooking his food, is to save him the trouble of chewing the cud, and to put the food into that state in which it is at once fit to be acted upon by the gastric juice. In doing this, we attempt to imitate and enter into competition with a complicated natural process, and, as might be expected in the circumstances, exhibit our inferiority. In the state, however, in which cooked food is presented to the ox, chewing the cud is not altogether saved him, as the straw which he chooses to eat undergoes that operation, and therefore assists in keeping that important function in exercise. It is doubtful that the ox would retain his wonted good health, were we able entirely to suspend the action of that function in him; and it is therefore questionable policy to attempt it to a farther degree than to reduce his food so small as to render it fit to enter the paunch, with still less mastication than he would have to give it in its ordinary state.

(1569.) The case, however, of the horse is very different. His is a single or simple stomach, which must be filled at once with well masticated food, before the gastric juice can act upon it in a proper manner; and should any food which enters it in an insufficiently masticated state, escape beyond the influence of the juice into the bowels, it may decompose there, generate gas, and produce the analogous disease of *hoven* in cattle, namely, flatulent colic or *batts*. To render food in such a state at first as shall save the horse the trouble of mastication, is, therefore, to do him a good service; and hence, cooked food is in a proper state for feeding a horse, and it has also been proved to be economical. Still, the cooking will be carried to an injurious degree, if it shall, by dint of ease of deglutition, prevent the flow of the sufficient quantity of saliva into the stomach which is necessary to complete digestion,—"the quantity of which," says Professor Dick, "is almost incredible to those who have not had an opportunity of ascertaining it, but which the following fact will testify. A black horse had received a wound in the parotid duct, which became fistulous. When his jaws were in motion in the act of eating hay, I had the curiosity to collect in a glass measure the quantity which flowed during 1 minute, by a stop-watch; and it amounted to nearly 2 drachms more than 2 oz. in that time. Now, if we cal-

culate that the parotid gland on the opposite cheek poured into the mouth the same quantity in the same time, and allow that the sublingual and sub-maxillary gland, on each side combined, pour into the mouth a quantity equal to the two parotids, we then have no less than 8 oz. of saliva passing into the mouth of a horse in one minute, for the purpose of softening the food and preparing it for digestion." * Yet it is impossible for any horse to swallow food in the most favourable state it can be made for swallowing, without moving his jaws to a certain degree, and this ensures a certain quantity of saliva entering his stomach.

(1570.) But more than this, cooked food may be presented in too nutritious a state for the stomach; and there may be, on the other hand, too little nutriment in the food given: For " the digestive organs of the horse, like those of the ox," says Professor Dick, " are very capacious, and are evidently intended to take in a large proportion of matter containing a small proportion of nutriment; and if the food upon which they are made to live is of too rich a quality, there is, by the excitement produced, an increase of the peristaltic motion, in order to throw off the superabundant quantity which has been taken into the stomach and bowels. It is necessary to give, therefore, a certain quantity of *bulk, to separate, perhaps, the particles of nutritious matter*, that the bowels may be enabled to act upon it properly. A horse could not live so well on oats, if fed entirely upon them, as when a portion of fodder is given; with them, a certain quantity is required. But this may be carried too far, and the animal may have his bowels *loaded* with too large a quantity of unnutritious food;" as witness the nature of the *steep* before alluded to; " and nothing less than such a mass as will render him incapable to perform any active exertion, will be sufficient to afford him even a scanty degree of nourishment. A horse living on straw in a straw-yard becomes pot-bellied. Hence it is, that a proper arrangement in the properties and proportions of his food becomes a matter of important consideration."† These and the preceding remarks comprehend all the rationale of feeding both cattle and horses, and, if carefully considered, may conduct you to adopt such an appropriate mixture of materials in your possession as may serve to maintain the strength, good health, and condition of your horses, on the one hand, and to do so economically on the other. Meantime, I shall enumerate a few of the attempts that have hitherto been made of making mixtures of food for horses, with the view of ascertaining whether cooked or raw food, in a prepared or natural state, maintains horses in the best order.

(1571.) The most careful set of experiments that have yet been recorded in supporting *farm*-horses on *boiled* and *raw* grain, and on raw grain *prepared* and in a *natural* state, was made by Mr James Cowie, Halkerton Mains, Kincardineshire. He subjected no fewer than 12 horses to the experiment, dividing them into 3 sets of 4 each, and keeping each set on a separate fare. The horses were weighed on 1st March, when the experiment began, and their weights varied from 9 cwt. 3 qrs. to 12 cwt. 1 qr. 4 lb.; and they were again weighed on 1st May, at the end of the experiment, and their weights then ranged from 9 cwt. 2 qrs. 23 lb. to 12 cwt. 1 qr. 14 lb. Thus the range of weight did not vary much at both the periods, though the individual weights did. Their ages ranged from 4 to 12 years. They were fed on this wise:—

* Quarterly Journal of Agriculture, vol. iii. p. 1025. † Ibid., p. 1031.

First Set.

2 on *cut* barley and beans, mixed, *raw.*
2 ... ... *boiled.*

Second Set.

2 on oats and beans, *raw.*
2 ... ... *boiled.*

Third Set.

2 on oats, *raw.*
2 ... *boiled.*

Each horse got 1 peck = 4 lippies = 4 feeds = about 16 lb. of grain daily, with oat-straw. The weight of the barley was 50 lb., and of the oats 42 lb. per bushel. The horses were not put suddenly upon a change of food, for Mr Cowie had been in the practice of giving them daily raw, cut, and boiled grain alternately. The experiment having been conducted at a season of heavy work, it is not to be wondered at that the horses lost some weight upon the whole; thus their gross weights on 1st March was 130 cwt. 2 qrs. 26 lb., and on 1st May it had only decreased to 124 cwt. 3 qrs. 22 lb., a difference only of 5 cwt. 3 qrs. 4 lb.; but as one horse only lost 5 lb., another kept his weight, and a third gained 10 lb.; 3 out of the 12 thus proving themselves quite able to stand heavy work, it was the remaining 9 that had to bear almost the entire loss of weight, which varied individually from 1 qr. 23 lb. to 3 qrs. 12 lb. The results of the losses and gains stand thus:—

	Cwt.	qr.	lb	Cwt.	qr.	lb
Total loss of weight of 6 horses on *boiled* grain,				3	2	27
Total loss of weight of 6 horses on raw grain,				2	0	15
Deduct gain by 1 horse,	0	0	10			
... same state of 1 horse,	0	0	0			
				0	0	10
				2	0	5
Average loss on each horse on *boiled* grain, *nearly*				0	2	14
... ..., *raw*, bruised, and unbruised, *nearly*				0	1	12

In the course of the experiment it was observed that one or two of the horses fed on boiled grain perspired more freely at their work than the others, and, what is remarkable, they drank less water, and their dung was a little softer, but with no tendency to purge.

(1572.) The facts brought out in this experiment were, that the horses fed on *unbruised raw* and on *boiled* grain, gave results so very nearly alike, that it seems inexpedient to incur the expense of *cooking* food for horses, as that costs about 1½d. on two feeds for each horse. This is a rather remarkable result, for one should have expected that the *boiled* grain would have had the advantage. *Bruised raw* grain seems the most nourishing, and, in not requiring cooking, of course, the most economical, mode of feeding work-horses. For, all the horses that had been on *boiled* and *unbruised raw* grain lost 70 lb. each; and that amount of loss in an animal of 10 cwt. or 12 cwt. is considerable; whereas those which had been on *bruised* grain, though given raw, either gained weight, or lost

none. And as to the economy of using grain in this state, *besides the cooking*, it is alleged that boiled whole grain passes through the horse undigested as well as raw grain when whole, and that the quantity which thus escapes is equal to $\frac{1}{6}$ of what a horse consumes; whereas, the grain that is *bruised* undergoes a considerable degree of digestion at least, before passing away. If the loss is taken at $\frac{1}{6}$ on a horse which gets 12 lb. daily of oats whole, a yearly saving might be effected of about 2 quarters of corn, by giving him 10 lb. of bruised instead.

(1573.) Many economical forms of mixtures have been recommended for farm-horses, and these are among them :—

10 lb. of chaffed straw, at L.1 per ton,	1d.
10 lb. of oats, at 3s. per bushel,	9
16 lb. of turnips, at 10s. per ton,	1
Expense of cutting and chaffing,	0½
Cost of one horse each day,	11½d.
16 lb. of hay, at 3s. 6d. per cwt.,	6d.
5 lb. of oats, at 3s. per bushel,	4½
16 lb. of turnips, at 10s. per ton,	1
Cost of one horse each day,	11½d.
28 lb. of steamed turnips,	3½d.
7 lb. of coals, at 1s. per bushel,	1
Expenses of steaming,	0½
16 lb. of straw, at L.1 per ton,	1½
Cost of one horse each day,	6½d.

This last mixture, containing no corn of any kind, is said to " succeed remarkably well, and although the horses perspired considerably while at work, they kept their condition exceedingly well," and has been adopted by some farmers in the south of England, and by Mr Karkeek, the veterinary surgeon, as having been " highly recommended by several practical farmers." * No doubt, horses can live upon turnips, as well as upon grass, without corn, and they may be said to work upon them; but I quite agree with Mr Stewart, when he observes,—" What the owner might call *work* is not known. In this country, grass alone will not produce workable horses," and the same may more truly be said of turnips and straw. " If food is not given," continues Mr Stewart, " work cannot be taken. Every man who has a horse has it in his power to starve the animal; but that, I should think, can afford little matter for exultation." † Turnips are frequently given to farm-horses in the evening in lieu of a feed of corn, and even in lieu of a hot mash at night; and horses are very fond of Swedish turnips, which, on being washed, are generally set before them whole, unless some of the men take the trouble of cutting them into slices with their knives; but the best way would be to have them sliced on purpose by Wallace's turnip-slicer, fig. 259,

* Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 347.

† Stewart's Stable Economy, p. 281.

which has been already described. Potatoes are given to horses in a raw state, in the same manner as turnips, and they seem to be relished by them, but not so fondly in so far as I have observed, as Swedish turnips. But of the sorts of food of the root kind, there is none which gives horses so much delight as the carrot. It is a pity that this root can only be cultivated successfully on very light soil, otherwise it would be worth while to raise as many at least as would support the horses, in conjunction with corn, all winter. Stewart says, that, "for slow-working horses, carrots may supply the place of corn quite well, at least for those employed on the farm." * They would get fat enough on 70 lb. of carrots a-day, but would want stamina without corn.† Carrots are easily and successfully grown in the island of Guernsey; but they are not given to horses on account of an allegation, that "when on this food their *eyes* are injured." The same writer mentions a similar effect produced by the parsnip at a certain season of the year. "To horses," he says, "parsnips are frequently given, and have the property of making them sleek and fat; but in working they are observed to sweat profusely. If new, and cut sufficiently small, no other ill effect results, except, indeed, at one period of the year, towards the close of February, when the root begins to shoot; if then given, both horses and horned cattle are subject, on this food, to an inflammation in the eye, and epiphora or watery eye; in some subjects, perhaps, producing blindness."‡ Horses are very fond of bread; a piece of bread, and especially oat-cake, will take a horse in the field when a feed of corn cannot. It is quite common in Holland to see travellers, at a village inn, take a black loaf and slice it down with a bread knife in a trough for their horse. Upon the principle of economy, M. Longchamp has proposed to feed the cavalry of France with a bread composed of $\frac{3}{4}$ of boiled potatoes and $\frac{1}{4}$ oatmeal, properly baked in an oven. The usual allowance of oats for a horse, at 10 lb., costs 13 sous; but 10 lb. of this bread will only cost 5 sous.

(1574.) But independent of all succedanea, which may be given to horses at times as a treat, and as affording a beneficial change of food, there should be a regular feed prepared for farm-horses, which should be administered every day, and any deviation from which should be regarded as a relish or treat. There are two formulæ which I shall give, which have been found to make excellent prepared food for farm horses, and they may be prepared without much trouble, provided the proper apparatus is erected for the purpose. The first is given in quantity of each day for one horse:—

In the morning,	$3\frac{1}{2}$ lb. of oat and bean meal, 11 lb. of chopped straw,	$14\frac{1}{2}$ lb.
At midday,	3 lb. of oat and bean meal, 12 lb. of chopped straw,	15 ...
At night,	$1\frac{1}{2}$ lb. of oat and bean meal, 11 lb. of steamed potatoes, 2 lb. of chopped straw,	$14\frac{1}{2}$ ...
		44 lb.

* Stewart's Stable Economy, p. 193.

† An error has crept into (1250.), where the specific gravity of the carrot is stated at 0.018, instead of 0.810.

‡ Quayle's Agriculture of the Channel Islands, p. 103.

This quantity is quite sufficient for the strongest farm horses, and less will be consumed by ordinary ones, but that can be regulated according to circumstances, by withdrawing a little meal and straw, still retaining the proportions. The usual allowance of oats, as you have seen, weighs 11½ lb. a-day, when the grain is of the finest quality; but as horses seldom receive the finest oats, and are usually supplied with what are called common oats, which do not weigh so heavy, the usual allowance may be taken at 10 lb.; and when hay is given to the horses in spring, they eat at least 1½ stone of 22 lb. = 33 lb. every day. This mixture, on the other hand, contains no hay, and only 8 lb. of oat and bean meal, or 6 lb. of barleymeal instead, if more convenient to be given, and 11 lb. of steamed potatoes, which cannot be estimated at much value on a farm beyond the cost of steaming.* The value of the ordinary and of the prepared food can easily be estimated, and it will be found that the prepared is the cheapest, and at the same time better for the horses' health, and equally well for them as to condition and spirit. The mixture is made in this way. The meal and chopped straw are put and mixed together in a tub, and a little salt sprinkled over it. The steamed potatoes are then poured hot into the tub over the straw, and the whole is formed into a mash with a shovel, and let stand a while to acquire an equal temperature throughout, and to swell the meal into a pulpy state with the potatoes, before being divided out to the horses.

(1575.) A formula is given by Professor Low, consisting of chopped straw, chopped hay, bruised or coarsely ground grain, and steamed potatoes by weight, in equal parts, with 2 oz. of salt; and of this from 30 lb. to 35 lb., or 32½ lb. on an average, to be given to a horse every day.† This mixture, including hay, will be more expensive than the above; and I am doubtful that 35 lb. of it will satisfy a farm-horse on active work in spring, when he can eat 33 lb. of unchopped hay a-day, besides corn.

(1576.) It appears at first sight somewhat surprising that the idea of preparing food for farm-horses should only have been recently acted on; but I have no doubt that the practice of the turf and of the road, of maintaining horses on large quantities of oats and dry rye-grass hay, has had a powerful influence in retaining it on farms. But now that a more natural treatment has been adopted by the owners of horses on fast-work, farmers, having now the example of post-horses standing their work well on prepared food, should easily be persuaded that, on slow work, the same sort of food should have even a more salutary effect on their horses. How prevalent was the notion, at one time, that horses could not be expected to do work at all, unless there was *hard meat* in them! "This is a very silly and erroneous idea, if we inquire into it," as Professor Dick truly observes; "for whatever may be the consistency of the food when taken into the stomach, it must, before the body can possibly derive any substantial support or benefit from it, be converted into *chyme*—a pultacious mass; and this, as it passes onward from the stomach into the intestinal canal, is rendered still more fluid, by the admixture of the secretions from the stomach, the liver, and the pancreas, when it becomes of a milky appearance, and is called *chyle*. It is then taken into the system by the lacteals, and in this *fluid*, this *soft* state—*and in this state only*—mixes with the blood, and passes through the circulating vessels for the nourishment of the system.‡" Actuated by these rational principles, Mr

* Quarterly Journal of Agriculture, vol. iv. p. 383.

† Low's Elements of Practical Agriculture, p. 497.

‡ Quarterly Journal of Agriculture, vol. iii. p. 1033.

John Croall, a large coach-proprietor in Edinburgh, now supports his coach-horses on 8 lb. of chopped hay and 16 lb. of bruised oats; so does Mr Isaac Scott, a postmaster, who gives 10 lb. or 12 lb. of chopped hay and 16 lb. of bruised oats, to large horses; and to carry the principle still farther into practice, Captain Cheyne found his post-horses work well on the following mixture, the proportions of which are given for each horse every day; and this constitutes the second of the formulæ alluded to above.

In the day,	8 lb. of bruised oats. 3 lb. of bruised beans. 4 lb. of chopped straw.	At night,	22 lb. of steamed potatoes. 1½ lb. of fine barley dust. 2 lb. of chopped straw. 2 oz. of salt.
	15 lb.		25½ lb.

Estimating the barley-dust at 10d. per stone; chopped straw, 6d. per stone; potatoes, steamed, at 7s. 6d. per cwt.; and the oats and beans at ordinary prices, the cost of supper was 6d., and for daily food, 1s. with cooking, in all 1s. 6d. a horse each day.*

(1577.) That horses will thrive on bruised *whins* or *furze*, I had considerable experience in the winter of 1826, to which expedient I was impelled in consequence of the heat of that summer burning up the straw of all sorts of grain on light soil. Old whins, growing in a fir plantation, supplied young shoots from 1 foot to 3 feet in length, which were cut by a field-worker with a hook, and led to the steading, where it was bruised with a beetle shod in the face with parallel slips of iron. Every man bruised as much in the morning, on a stone floor, in 20 minutes, as served his pair of horses for the day. The horses relished it better than hay, and got in remarkably fine condition and coat. When the olders prays of whins are used, a more powerful machine than the one described is required to bruise them into a fit state to be eaten by horses. I have seen an old cart-wheel used, placed on its ring and made to revolve in a circular trough; but there is a better plan, of mounting an old mill-stone on a 12-feet horizontal axle, attached by one end to the top of a stout post, round which the stone revolves on a paved circular bed, 8 feet in diameter; and a horse is yoked with a swing-tree at the other end of the axle to draw the stone round on its edge in the trough, in which the fresh whins are placed, and when bruised taken out ready for use.

(1578.) [*Hay and Straw Cutters.*—Machines for chopping hay and straw form now an important article in the class of implements for preparing food for horses and cattle. In England, the straw-cutter or chaff-cutter is held, very properly, in high estimation by the farmer, and its value, in an economical point of view, seems to be fully appreciated by all. In Scotland, with all its boasted economy in the various walks of agriculture, the straw-cutter is but partially employed, and it is chiefly amongst those farmers who, to a well established experience, superadd scientific skill, that the employment of the straw-cutter, together with the other members of the class of food-preparing machines, are brought to bear upon the establishment in a systematic form. There can be no doubt that ere long the food-preparing system will become as universal amongst farmers as the thrashing machine is already, and straw-cutters, corn-bruisers, and steaming-apparatus, will be seen in every well-regulated steading. To the full develop-

* Quarterly Journal of Agriculture, vol. iii. p. 1029.

ment of such a system there exists one especial obstacle, which is, that defect, in the minds of many men, which prevents their forming a systematic arrangement of any given subject, and from being indifferently qualified to draw conclusions from a series of facts, which individually appear isolated and loosely connected, but which, in the aggregate, are capable of bringing out important results. For example, there are many individuals who may have procured the requisite machinery to have enabled them to follow the system here alluded to, but, owing to the absence of properly organized methods of procedure in the different processes, and losing sight of the advantages to be derived from a proper combination of effects, by viewing only the results in detail, the well intended trial ends in disappointment, and the machinery set aside as unprofitable; whereas, under proper direction, it would certainly have achieved the object. In using machinery of this kind, it should always be borne in mind, that the more constantly and regularly it is kept in operation, so much the more productive will it be in saving expense to its proprietor, provided such machinery be of a kind that can be rendered available as a means of saving expense; and, from the nature of things, no machine will be continued in any practice after it has been ascertained to possess only negative properties.

(1579.) Straw-cutters are of very various construction, rising in the perfection and complication of parts, from the simple knife, jointed at one end to a table, and wielded by the right hand, as a lever of the second order, chopping the straw or hay that is presented to it by the left. From this simple and primitive form they rise in gradation to a class of elaborate machines, too numerous to be described individually, but out of which the following varieties are selected as appearing most worthy of attention. I shall pass over some of the early machines, which, however ingenious, were unnecessarily complicated; such as those which enjoyed the advantage of a revolving web to carry forward the substance to be cut, and having also the means of moving the substance, not uniformly, but by starts, the progressive action being performed in the interval of the strokes of the cutter, the substance, at the same time, being alternately compressed and relaxed, that is, compressed while the knife is cutting, and relaxed during the progressive stage. Such mechanical appliances are now, for the most part, laid aside, and the machine is proportionally simplified.

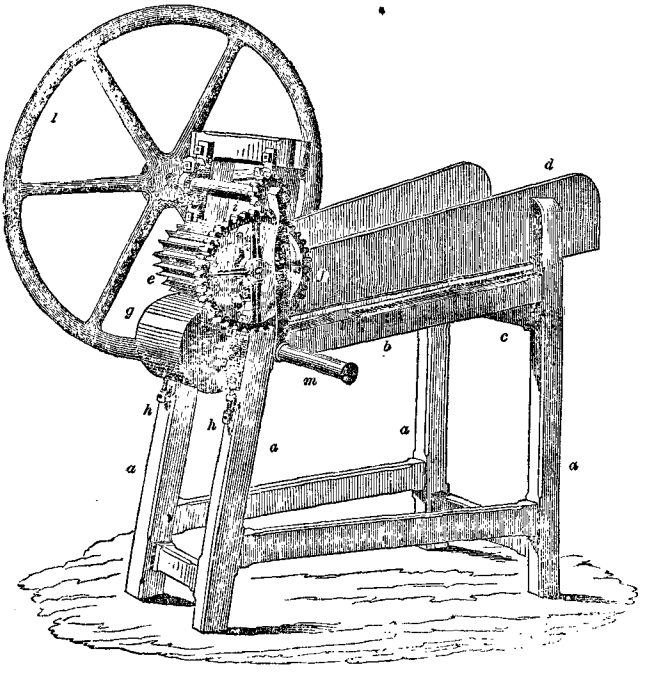
(1580.) The straw-cutting machines now in general use may be arranged under three varieties, and in the order of seniority stand as follows:—1. Those having the cutting knife or knives attached on the disc of a fly-wheel. 2. Those having the knives placed upon the periphery of a skeleton cylinder; and 3. Those having numerous knives set round the surface of a small solid cylinder. This last being the simplest form of the modern machine, I shall place it first in the order of description.

(1581.) *The Canadian Straw-cutter.*—This machine, as the name implies, is an importation from Canada, a description of it having been sent from thence by Mr Fergusson of Woodhill, now of Fergus, Upper Canada, to the Highland and Agricultural Society, in whose Transactions it was first published,* but the present figure is taken from the machine as made by James Slight and Company, who have greatly improved the construction of the cutting cylinder. Fig. 281 is a view in perspective of this machine. It consists, first, of a wooden frame, of which *a a a a* are the four posts, 2¼ inches square, the front pair 43 inches in height, and the back pair 36 inches. These are con-

* Prize Essays of the Highland and Agricultural Society, vol. xii. p. 337.

nected by two side-rails, one of which is seen at *b*, and a cross-rail *c*, which last serves also to support the bottom of the feeding spout. These rails are 2½ inches deep by 1½ inch in thickness. The posts are further connected by four light stay-rails below; and the frame, when thus joined, measures 15 inches in width

Fig. 281.



THE CANADIAN STRAW-CUTTER.

at the front, where the rollers are applied, 22 inches in width behind, and 40 inches in length at bottom, but only 36 inches at the top-rail, measured over all. The feeding spout *d* is 40 inches in length, 9 inches in width within, at the feeding end, and 18 inches behind; the depth is 4 to 6 inches.

(1582.) The acting parts of this straw-cutter consist of the cutting cylinder *e*, which is 9 inches in length and 6½ inches in diameter to the edge of the cutters. It is armed with 24 cutters or knives; its axle runs in plummer-blocks, bolted upon the posts, and carries likewise the wheel *f* of 9½ inches diameter. The pressure cylinder *g* is a plain cylinder of hardwood, beech or elm, turned true upon an iron axle, which runs in plummer-blocks similar to the former. The length of the pressure cylinder is 9 inches, and its diameter 7 to 8 inches; it carries no wheel, but revolves by simple contact with the cutting cylinder. The pressure cylinder is furnished with a pair of adjusting screws at *h h*, which act upon the plummer-blocks of the cylinder, and afford the means of regulating the pressure of the one cylinder upon the other. The shaft *i*, which has also its plummer blocks, carries at one end a pinion of 3¼ inches diameter, which acts upon the wheel *f*, while, at the other end, it carries the fly-wheel *l* of

34 inches diameter and 60 lb. weight. The winch-handle *m* is also attached to the shaft *i*, and serves to put the machine in motion.

(1583.) Fig. 282 is a transverse section of the cutting cylinder, shewing the position of the cutters and their insertion into grooves which are planed out of the solid cast-iron forming the body of the cylinder; *a* is the axle, and *b* the body of the cylinder, which is 4 inches in diameter, and has 24 cutters inserted

Fig. 283. Fig. 282.

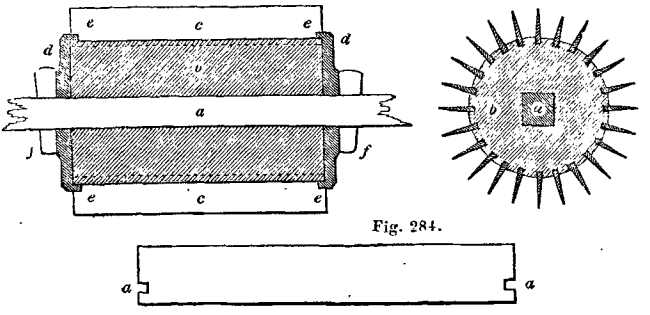


Fig. 284.

SECTIONS OF THE CUTTING CYLINDER.

in its periphery. Fig. 283 is a longitudinal section of the same, for the purpose of exhibiting the manner in which the cutters are secured in their places *a* is the axle, and *b* the body as before, *c c* being two opposite cutters. The body is 8 inches in length, but is furnished with two caps *d d*, which make it up to 9 inches. The caps are cupped out, so that their edges *e e e e* embrace the ends of the body, and at the same time enter into notches cut in each end of the cutters, as seen in fig. 284, which is a cutter detached, and drawn to a larger scale, exhibiting the notch *a a* into which the edge of the cupped ends enter. By this arrangement, the numerous cutters are all held firmly in their grooves; for so soon as the caps are applied, and fixed by the keys *f f*, fig. 283, being driven through the axle, the caps are pressed home upon the body and the cutters. On the other hand, when it is found requisite to remove a cutter, for sharpening or other purposes, it is only necessary to drive out one of the keys *f*, to withdraw the cap, and the cutters can be lifted out of their grooves without trouble.

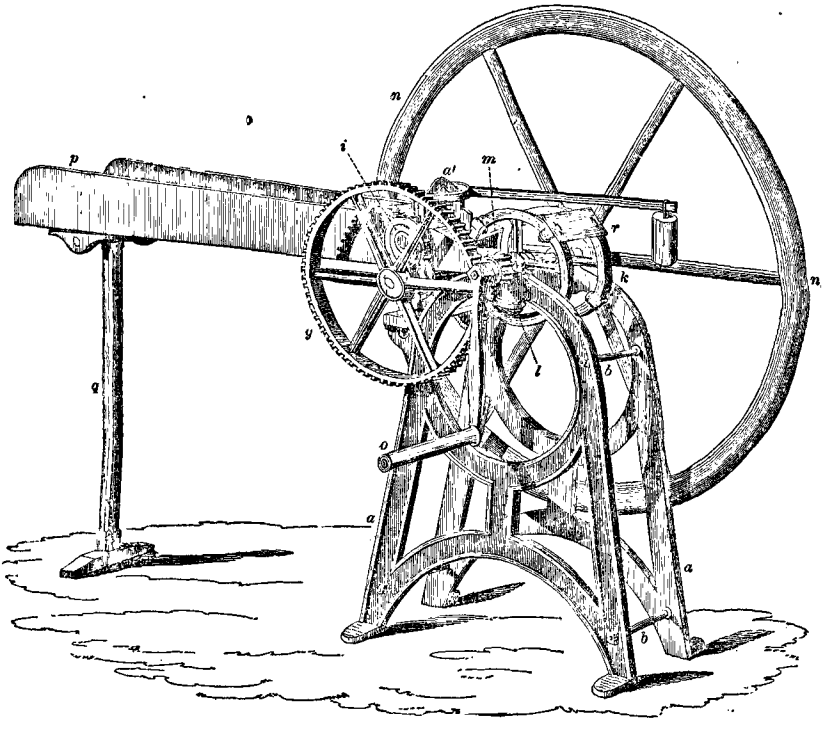
(1584.) As this machine acts entirely by direct pressure, it will readily be observed, that, in working it, the straw being laid in the trough *d*, fig. 281, and brought in contact with the cutting cylinder and its antagonist, the hay or straw will be continuously drawn forward by means of the two cylinders; and when it has reached the *line of centres* of the two, it will be cut through by the direct pressure of the cutting edges of the one against the resisting surface of the other cylinder, and the process goes on with great rapidity. The straw is cut into lengths of about $\frac{3}{4}$ inch; and though it passes in a thin layer, yet the rapidity of its motion is such, that when driven by hand, at the ordinary rate of 44 turns of the handle per minute, the number of cuts made by the cutting cylinder in that time is 360; and the quantity compared by weight, will be three times, nearly, what any other straw-cutter will produce, requiring the same force to work it, that is to say, a man's power. There is one objection to this machine, which is, the wearing out of the resisting cylinder; but this is ba-

lanced by the excess of work performed, and by the circumstance that the wearing cylinder can be removed at an expense not exceeding 2s., and it will last from 3 to 6 months. The price of the Canadian straw-cutter is L.6, 10s.

(1585.) *Cylinder Straw-cutter*, so named here from its having the knives or cutters (generally two, but sometimes four) placed on the periphery of a skeleton cylinder, the knife lying nearly in the plane of revolution. Besides the cutting cylinder, they necessarily have a pair of feeding rollers, which bring forward the substance to be cut, and also, from the velocity of their motion, regulates the length of the cut. Two forms of the machine exist, the essential difference of which is, that, in the one, the cutters are placed upon the cylinder with a large angle of obliquity to the axis, generally about 35°, and are therefore bent and twisted until their edges form an oblique section of the cylinder, while the box, or the orifice through which the substance is protruded for being cut, lies parallel to the axis of the feeding rollers. In the other variety, the knives are placed parallel to the axis of the cylinder, and therefore straight in the edge, while the cutting-box is elongated into a nozzle, and is twisted to an angle of 15° with the axis of the feeding-rollers. To this form of the machine I shall at present chiefly confine myself.

(1586.) The cylinder straw-cutter with straight knives, as constructed by

Fig. 285.

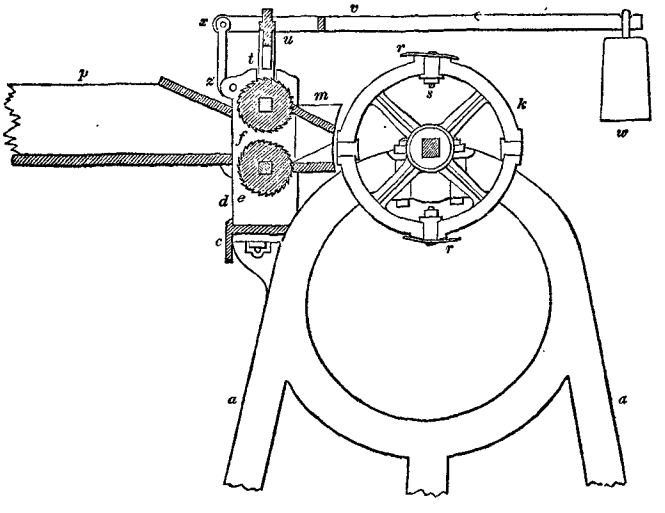


THE CYLINDER STRAW-CUTTER WITH STRAIGHT KNIVES.

James Slight and Co., Edinburgh, at prices from L.7, 10s. to L.8, 10s., is repre-

sented by fig. 285, being a view in perspective of the machine, while fig. 286 is a section of the principal parts; and in the two figures the same letters refer to the corresponding parts of each. The machine is made entirely of iron, chiefly cast-iron. The two side-frames *a a*, are connected together, at a width of from 12 to 15 inches, by the stretcher-bolts *b b*, two of which are seen in the right-hand side of the figure, and a third below on the left; a fourth is formed of the bed-plate *c*, which is bolted to a projecting bracket, and carries the cheeks or frame *d* of the feeding-rollers *e* and *f*. The lower roller *e* carries upon its axle the driving-wheel *g*, and also the feeding-wheel, indistinctly seen in the figure, but which works into its equal wheel *i*, fitted upon the axle of the upper roller *f*. In the machine, when adapted for hand-power, the rollers vary from 5 to 8 inches in length, and are 3½ inches in diameter, and fluted. In the apex of the side-frames, bearings are formed for the axle of the cutter-wheels *k*, which form the skeleton cylinder, and whose axle carries also the driving-pinion *l*, acting upon the wheel *g*. The cutter-wheels are 11 inches diameter, and are set at from 10 to 13 inches wide. Intermediate between the feeding-rollers and the cutter-wheels is placed the cutting-box or nozzle *m*, bolted to the roller-frame in the position represented in fig. 286. On the further end of the cutter-wheel axle the fly-wheel *n*, of 4 feet diameter, is fixed; and on the near end of the same, the winch-handle *o*, by which the machine is worked. The feeding-trough *p* is 4 feet in length, from 5 to 8 inches wide at the feeding end, and 18 inches behind. The depth is 6 inches, and the trough is formed of ¾-inch deal. It is hooked to the roller-

Fig. 286.



A TRANSVERSE SECTION, SHEWING THE RELATION OF THE PRINCIPAL PARTS.

frame at the mouth, and is supported behind by the jointed foot *q*. The cutters *r r*, from 10 to 13 inches in length, and 3½ to 4 inches in breadth, are made of the finest steel, backed with iron. The cutters are fixed upon the cylinders, each with two screw-bolts, as seen at *s*, passing through the ring of the

wheel, and they are placed slightly eccentric to it; the cutting edge being about $\frac{1}{4}$ inch more distant from the centre than the back. To secure the regular feed of the rollers, the lower one turns in fixed bearings; but the other is at liberty to rise and fall in the fork *t* of the roller-frame. In order further to secure a uniform pressure on this roller, a bridge *u* is inserted in the fork *t*, resting on both journals of the roller. A compensation lever *v*, has its forked fulcra in *x* through the strap *x z*, which is hooked on to pins in the roller-frame; and it thus bears upon the bridge *u* at both sides by means of the forked end, as seen at *a'* in fig. 285. A weight *w* is appended to the extremity of the lever, which, thus arranged, keeps a uniform pressure on the upper roller, while it is always at liberty to rise or fall according to the thickness of the feed which the rollers are receiving.

(1587.) Fig. 287 is a direct front view of the cutting-box detached, on a scale of 2 inches to a foot. *a a* are the ears by which it is bolted to the roller-

Fig. 287.

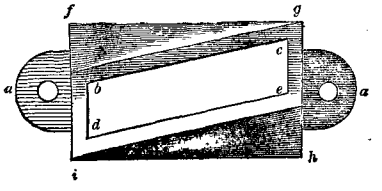
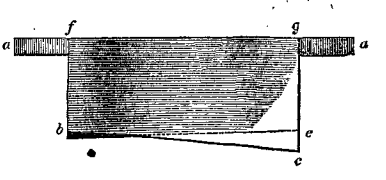


Fig. 288.



THE CUTTING BOX DETACHED.

frame; *b c* and *d e* are the upper and lower extreme edges of the nozzle, while *f g h i* is the base, as applied to the roller-frame. The angle *b g f* or *e i h* is the obliquity which is given to the nozzle, and is about 15° with the horizontal axis. Fig. 288 is a plan of the same, in which the same letters of reference apply to the corresponding parts. *f g* is the base, lying on the same plane with the ears *a a*. The curve line *b c* is the contour of the upper edge of the nozzle, and the dotted line *b e* represents the lower edge *d e* of fig. 287.

(1588.) The obliquity of the nozzle, as here represented, serves the purpose of causing the knife to make a progressive cut, approaching to the effect of clipping; thereby preventing the shock that would otherwise arise, were the nozzle and the edge of the knife parallel at the instant when the cut commences. The action of the machine would perhaps be improved by an increased obliquity of nozzle, as the stroke of the knives would thus be still less felt; but this could not easily be done, unless the knife were placed oblique also in the opposite direction. But this involves a difficulty which the present machine was intended to obviate, namely, the preserving a straight-edged knife, which, in the hands of an unskilled workman, is much easier adjusted than a twisted one. And further, a moderate degree of obliquity is preferable to an excess; in the former, the intervals of the cuts are so considerable as to allow the fly-wheel to exert its natural effect of storing, as it were, a quantity of momentum or force, which it freely gives out to meet the resistance of the next cut; when, on the contrary, the obliquity is very great, as is frequently the case in the machines with twisted knives, and more especially when there are four cutters applied to the cylinder, there may, in such cases, be no interval of action in the cutters, for before one has completed its cut, the next has commenced, and the advantages of a

fly-wheel are, in such cases, nearly, if not altogether, lost; hence we find that some of the machines with twisted knives are extremely heavy to work.

(1589.) There is, however, another cause of increased labour in the working of some straw-cutters, on the principle now before us. In many of the cylinder machines, the cutter-wheels are of a diameter so large as to render the operation of cutting with them one of great labour. This arises from the circumstance of the action of the machine being a combination of the effects of the lever. The winch-handle is a lever, say of 12 inches radius, and the radius of the cutter-wheel, measured to the edge of the cutter, may be taken at 6 inches; here there is a mechanical advantage of two to one in favour of the power. Let the cutter-wheel be increased to 16 inches, or a radius of 8 inches, the proportion of the leverage is now materially changed, and the mechanical advantage in favour of the power is only $1\frac{1}{2}$ to 1. The power, therefore, suppose it exerts in the first case a force of 30 lb., it will require, in the second case, a force of 40 lb., to overcome the same resistance, and so on in that proportion. But the fly-wheel, under the like circumstance, loses part of its effect, though not to the same amount; for, suppose its radius to the centre of gyration to be 2 feet, the mechanical advantage of its momentum would be, in the first case, as 4 to 1, and in the second, as 3 to 1. In the construction of all cylinder straw-cutters, therefore, it is of importance to make the cutters of small diameter, that is to say, never to exceed 11 inches. It were, perhaps, better that they should be less than this, but on no account should they exceed it, especially for hand-machines. In the case of steam or water power, any small increase of resistance is less important, provided that a countervailing object is to be attained by it, such as a machine already made, or the like.

(1590.) While on the subject of *fly-wheels*, it may not be out of place to make a few remarks, pointing out where those auxiliaries to machinery may with propriety be applied, and where they ought not. In the first place, it may be asserted, that in no case can a fly-wheel act as a *generator* of power; and under a false impression of this supposed function of fly-wheels, numerous instances occur of their misapplication, or at least a misconception of their effects; and, secondly, the only available function of fly-wheels is their capability of acting as *reservoirs* of that power or force that is communicated to them while in motion. Thus a comparatively small force applied to a heavy fly-wheel for a few seconds, will, on the principle of its absorbing and partially retaining that power and force, accumulate a momentum that may, through the agency of mechanical means, be discharged on a particular point, and produce an instantaneous effect that the first mover never could accomplish without such means. This is finely exemplified in the machine for punching and cutting thick iron plates and bars; and the principle applies in all cases where fly-wheels can be employed with advantage. The principle of action is this. Fly-wheels may be employed with advantage in every case where the intensity of either the *power* or the *resistance* is variable; and where both are variable, it becomes still more necessary. On the other hand, where both the power and the resistance are uniform, a fly-wheel may be held as an incumbrance, and can only act as a load upon the first mover. In the steam-engine, for example, of any form in which a crank is used to communicate motion to machinery, the fly-wheel is indispensibly necessary; and such is the requisite governing power of fly to keep up steady motion, that its momentum is sufficient to compensate for considerable variation in the resistance of the machine or machinery upon which it ope-

rates. With water-wheels, however, the power is perfectly uniform, and if the resistance is also uniform, as in grist-mills and even thrashing-mills, fly-wheels would be worse than useless; but where the resistance is intermitting, such as rolling and tilt-mills, and punching machines, a heavy fly becomes necessary, in which the power of the first mover can be accumulated for a short period, and which will be expended during the succeeding short period that the driven machine is in action. In every case where manual power is applied, fly-wheels are useful if not essential. This arises from the power itself being variable; for the power of a man working a winch varies according to the different positions which the winch occupies in the course of its revolution, and has been ascertained to range in the proportion of 30 lb. and 60 lb. The rationale of this is, that when he is in a position that restricts his exertion to 30 lb., he might not be able to overcome the resistance unless at a very slow rate; but in the position where he can exert a force of 60 lb., he can do more than overcome the resistance. And here it is that the fly-wheel comes to his aid; for suppose the resistance requires an actual force of 45 lb., while he is putting forth 60 lb., there is a surplus of 15 lb. This last quantity the ever-ready fly-wheel, whose velocity, from its inertia, he is not able greatly to increase; but it takes up, with a small increase of velocity, the surplus force exerted by the hand, and this is stored up in the mass of the wheel, to be delivered out again at the next weak point in the revolution of the winch. Hence, a nearly equable force is produced to act upon the machine to which the power of the man is directed. If this power is directed upon an intermitting machine, such as a straw-cutter, the demands upon the fly-wheel are very much increased; but as the point of the machine to which the power is applied moves at a much slower velocity than the centre of gyration in the fly, and as the intermissions of the resistance are not likely to coincide exactly with the increments or decrements of the power, there will be a mutual compensation going on amongst the forces to bring out a uniform result. There is a possibility that a coincidence of the above circumstances may occur; hence, it is sometimes of consequence to observe the placing of the winch, so as to counteract any defect of compensation.

(1591.) The power of horses to impel machinery being of nearly uniform intensity, requires no regulator in itself; but it comes under the general law, if the resistance is intermitting. Thus, in the thrashing-machine, which is slightly variable in resistance, it would, if worked with horse-power, be considerably improved by the addition of a well proportioned fly-wheel, of which more in another place. In various other machines worked with horse-power, where the resistance is frequently-intermitting, such as blowing bellows, pumping, and the like, a fly is indispensable; while in a malt or other mill, whose resistance is uniform, the fly would be an incumbrance. Steam-power applied to a thrashing machine requires, as already observed, no additional fly-wheel; but that of the steam-engine for such purpose, should be above the standard allowed for ordinary purposes.

(1592.) The general theory of the application of fly-wheels may be repeated in a few words. They are usefully employed in all cases of intermitting resistance and of variable force, whether in the first mover or in the resistance. Where the motion is uniform and not intermitting, the first mover being also uniform, the fly-wheel is in almost every case unnecessary, and frequently an obstruction.

(1593.) The determination of the weight of a fly-wheel for any given purpose, is a problem not very definite in its results; but approximations to it have

been made by men of eminence. Amongst these, we find Tredgold stating a rule for the fly-wheels of steam-engines,* which, for practical purposes, is convenient, and comes near to the general practice; though this is to be taken with considerable latitude, seeing that the practice of engineers differs considerably on this point; and the rule, though it applies to heavy fly-wheels with tolerable exactness, does not agree with practice in the case of fly-wheels for the hand, and other small machines. But the following approximation will be a tolerable guide in practice for the weight of small fly-wheels.

(1594.) Taking the average force that a man will exert in turning a winch of 12 inches radius at 23 lb., when he turns it 45 times per minute, the rule will be—

RULE.—Multiply 20 times the force in pounds exerted on the winch by its radius in feet, and divide this product by the cube of the radius of the fly-wheel in feet, multiplied into the number of the revolutions per minute; the result will be the area of a section of the rim of the fly, in square inches.

EXAMPLE.—The force applied to the winch being 23 lb., its radius 1 foot, and the revolutions per minute 45; required the section of the rim of a fly-wheel whose radius is $1\frac{1}{2}$ foot, or 3 feet diameter.

$$\frac{20 \times 23 \times 1}{1.5^3 \times 45} = \frac{460}{151} = 3 \text{ inches, the area of section of the rim nearly.}$$

(1595.) Though this formula will serve for small fly-wheels, whose velocities range from 40 to 80 revolutions per minute, it becomes necessary, in order to make it agree with practice, to change the constant. Thus, for velocities ranging from 80 to 150, the number 10 will be substituted for 20; and from 150 to 300, the number 5. In this last case, the fly-wheel cannot exceed 2 feet diameter; and, in the former, it is restricted to 3 feet.

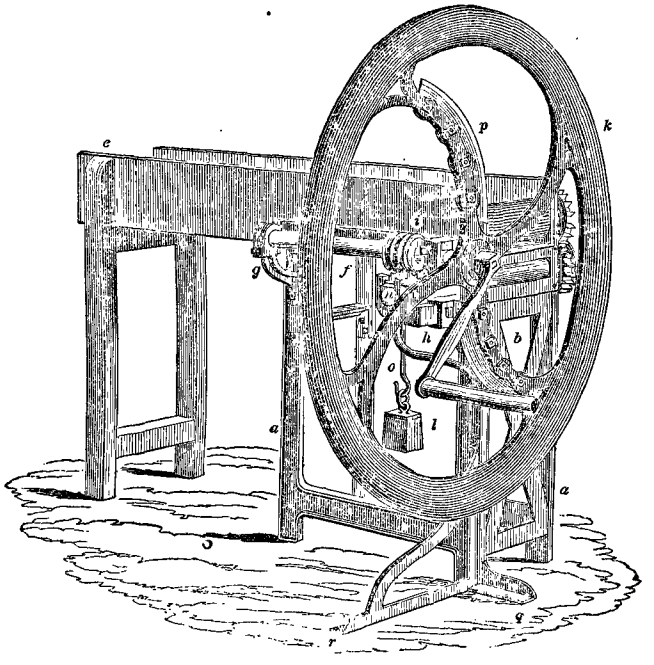
(1596.) *The Disc Straw-cutter.*—Of the disc straw-cutter the varieties are very numerous, and they form a very important order of this machine; being that, also, which is, for the most part, employed in England, it is the most numerous of the class. The principal feature, the cutting-knife, fixed upon the fly-wheel, is invariable, except that it sometimes carries one, at other times two knives. The machinery or details are exceedingly varied. In some, it is adapted to cut of various lengths by means of ratchet-wheels and lever-catches applied to the motion of the feeding-rollers, and at the same time to move the substance forward only in the intervals of the stroke of the knife; in others, the latter qualification only is attended to; in a third, a continuous motion of the substance is deemed sufficient; and these varieties of motion are produced by other and various arrangements of spur, bevel, and screw, geerings.

(1597.) The machine selected for illustration is one in which two knives are employed, and which gives to the substance to be cut a continuous motion forward. The figure here representing this, is taken from a machine manufactured by John Anderson and Son, founders, Leith Walk, at a price of L.10, 10s. Fig. 289 is a view of this machine in perspective. The chief parts of the frame-work are of cast-iron, consisting of a frame *a a* on each side of the machine, which are supported transversely by the truss *b*. The front part of the side-frames ex-

* Tredgold on the Steam Engine, p. 236.

tend upward and form the feeding-roller frame. The cutting-plate is attached in front of the latter portion of the frame-work, and is dressed truly off for the passage of the knife over its face. The feeding-trough *e* is connected in

Fig. 289.



THE DISC STRAW-CUTTER WITH CONVEX KNIVES.

the fore-part to the roller-frame, and along its bottom to the upper edge of the side-frames. The back end of the trough is supported in a light wooden frame. The principal shaft *f* is supported on two projecting brackets *g* and *h*, and upon it is mounted the single-thread screw *i*, and the fly-wheel *k*; on the extreme end also of the shaft the winch-handle *l* is attached. A bracket carries one end of a small shaft, on which the screw-wheel *n*, of 21 teeth, is mounted, and is turned by means of the screw, when the fly-wheel is put in motion. On the opposite end of the small shaft *n*, a spur-wheel is also placed, and acts upon another of equal diameter placed on the axle of the lower feeding-roller. This last, as well as the upper roller, are furnished with the usual long-toothed pinions, for admitting of the rise and fall of the upper roller. The upper roller is supported in a light frame that rises and falls in a slide of the roller-frame, and this is acted upon by a lever and weight, of which the hook only is seen in the figure at *o*. The cutting-knife *p* is 18 inches in length, and 4 inches in breadth. It is firmly bolted upon the arm of the fly-wheel, and its cutting edge, which is convex, is so formed that every successive point, in passing the edge of the cutting-plate, forms equal angles with the edge of that plate. In many of the

disc machines, the cutting edge of the knife is concave, formed on the same principle of equal angles, and, in effect, is the better of the two.

(1598.) The dimensions of the principal parts of this machine are as follows. Width of the frames 14 inches; length of cast-iron frames 30 inches, and height 3 feet; length of feeding-rollers 12 inches, and their diameter $4\frac{1}{4}$ inches; length of feeding-trough 5 feet, and width 12 inches. The fly-wheel is 4 feet 3 inches diameter, and the height to its centre is 3 feet. From the entire weight of the fly-wheel being supported at one angle of the frame, the spreading brackets *q r* are attached, to give the machine stability.

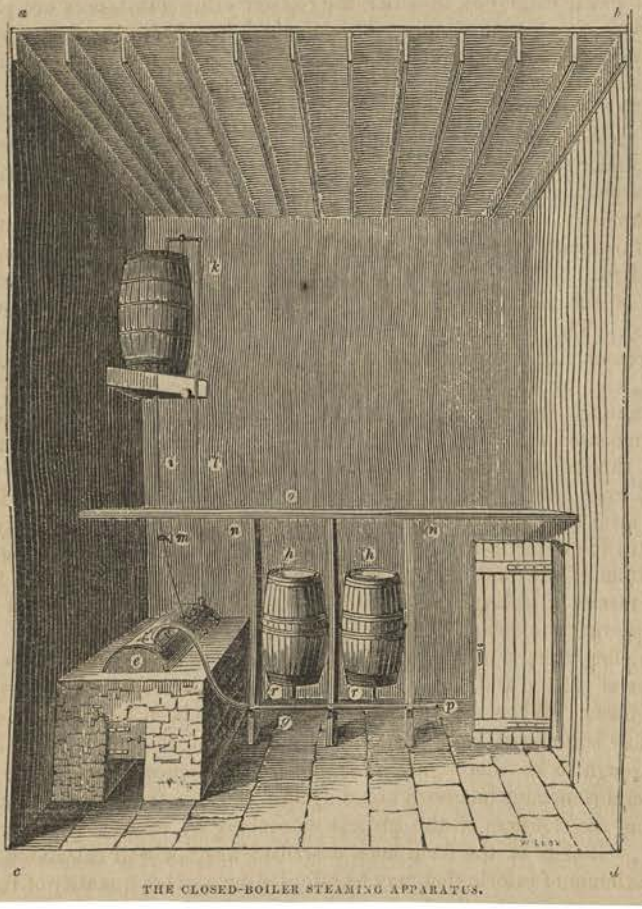
(1599.) *The Steaming Apparatus.*—The means employed for cooking food for horses and cattle, are either boiling or steaming. In the first, an open vessel is of course employed, in which the roots or other substances are placed, with a sufficient quantity of water. This method has been found inconvenient in many respects; and when the establishment is extensive, the vessel is required to be incommodiously large, and is withal not economical.

(1600.) Steaming in a separate vessel has been adopted in preference to the former method, and has been followed in a variety of forms, but these may be ranked under two distinct kinds. The first is an open vessel, a boiler, generally of cast-iron, having a channel or groove of 1 inch wide and 2 inches deep formed round its brim. The vessel is placed over a furnace properly constructed, and is partly filled with water. The groove is also filled with water. A sheet-iron cylindrical pan, of 3 to 4 feet in depth, and of a diameter suited to pass into the groove of the water-vessel (which is generally about 3 feet diameter), is also provided. The pan has a perforated bottom, to admit steam freely from the lower vessel. It is also furnished with an iron bow by which it can be suspended, and by which it can be conveniently tilted while suspended. This is the steaming pan; and for the purpose of moving it to and from the boiler, a crane, mounted with wheel and pinion and a chain, completes the apparatus. To put this in operation, the pan is filled with the substances to be steamed, and covered over either with a deal cover or with old canvass bags. It is then placed upon the boiler by means of the crane, and the fire being pretty strongly urged till the water in the boiler gives off its steam, which, passing up through the bottom of the pan, and acting upon the contents, produces in a few hours all the results of boiling. The water in the groove of the boiler serves as a sealing to prevent the escape of steam without passing through the pan. But notwithstanding this, it is evident that the steam can hardly ever reach the temperature of 212°; and hence, this apparatus is always found to be very tardy in its effects. When the contents of the pan have been found sufficiently done, the whole is removed from the boiler by means of the crane, and tilted into a large trough to be thoroughly mixed, and from thence served out to the stock. A general complaint has been urged against this construction of apparatus, arising from the slowness of the process of cooking by it, and consequent expense of fuel. Boilers of the form here described are not well calculated to absorb the maximum of caloric that may be afforded by a given quantity of fuel, neither is the apparatus generally the best adaptation for the application of steam to the substances upon which the steam has to act. Such boilers, as already observed, can never produce steam of a higher temperature than 212°. If they did, the shallow water-luting, formed by the marginal groove, would be at once thrown out by the steam-pressure; for it is well known, that the addition of 1° to the

temperature of the steam increases its elasticity equal to the resistance of a column of water about 7 inches high. A groove, therefore, of 7 inches in depth would be required to resist the pressure, which would even then be only $\frac{1}{5}$ lb. of pressure on the square inch. Under such circumstances, the temperature in the steaming-pan will always be under 212°. Hence the tedious nature of the process by using this apparatus.

(1601.) The apparatus which deserves the precedence of the above mode is here represented in fig. 290. The principle of its construction is that of a closed boiler, in which the steam is produced under a small pressure of 3 to 4 lb. on the

Fig. 290.



THE CLOSED-BOILER STEAMING APPARATUS.

inch. It is then delivered through a pipe to one or more separate vessels containing the substances that are to be cooked; and these vessels are so arranged as to be readily engaged or disengaged with the conducting steam-pipe. The outline *a b c d* of the figure represents a section of the steaming-house, with the apparatus in due order of arrangement, and of the extent that may be capable of

supplying an establishment of from 10 to 16 horses. The boiler *e* is of a cylindrical form, 20 inches in diameter and 4 feet in length. It is set in brickwork *f*, over a furnace of 14 inches in width, with fire-grate and furnace-door. The brick building requires to be 6 feet 6 inches in length, 4 feet 6 inches in breadth, and the height about 3 feet 6 inches. The furnace is built with a circulating flue, passing first to the further end of the boiler, then turning to right or left according as the chimney may be situated, returns to the front of the boiler, and terminates in the chimney on the side opposite to the first turning. The flues should be not less in width at the upper part than one-fourth the diameter of the boiler; and their height will be about one-third the diameter. The steam-pipe is attached to the boiler at its crown, takes a swan-neck bend downwards to within 12 inches of the floor at *g*, and terminates at *p*; it is furnished with as many branch nozzles as there are intended to be steaming-vessels. The steam-pipe may be either cast-iron or lead, and 2 inches diameter in the bore. The receptacles or steaming-vessels *h h* are usually casks of from 50 to 100 gallons contents. They are mounted with 2 iron gudgeons or pivots, placed a little above mid-height; they are besides furnished with a *false* bottom, supported about 3 inches above the true bottom; the former being perforated with a plentiful number of holes, to pass the steam which is introduced between the two bottoms. The connection between the steam-pipe and the receptacle may be either by a stop-cock and coupling screw—which is the most perfect connection—or it may be by the simple insertion of the one nozzle within the other, in the form of a spigot and faucet. In this latter case, the nozzle that leads from the steam-pipe is stopped with a wooden plug, when the receptacle is disengaged. Besides the steam-pipe, the boiler is furnished with a pipe *i*, placed in connection with a cistern of water *k*, the pipe entering into it by the bottom, and its orifice closed by a valve opening upward, the lower extremity of the pipe passing within the boiler to within 3 inches of its bottom. A slender rod *l* passes also into the boiler through a small stuffing box; and to its lower end, within the boiler, is appended a float, which rests upon the surface of the water within the boiler. The upper end of this rod is jointed to a small lever which has its fulcrum supported on the edge of the cistern a little above *k*; the opposite end of the lever being jointed to a similar but shorter rod, rising from the valve in the bottom of the cistern. This forms the feeding apparatus of the boiler, and is so adjusted by weights, that when the water in the boiler is at a proper height, the float is buoyed up so as to shut the valve in the cistern, preventing any further supply of water to pass into the boiler, until, by evaporation, the surface of the water has fallen so far as to leave the float unsupported, to such extent as to form a counterpoise to the valve, which will then open, and admit water to descend into the boiler, until it has again elevated the float to that extent that will shut the valve in the cistern. By this arrangement, it will be perceived, that the water in the boiler will be kept nearly at a uniform height; but to accomplish all this, the cistern must be placed at a certain fixed height above the water in the boiler, and this height is regulated by the laws which govern the expansive power of steam. This law, without going into its mathematical details at present, in so far as regards this point, may be stated in round numbers as follows:—That the height of the surface of the water in the cistern must be raised above the surface of that in the boiler, 3 feet for every pound-weight of pressure that the steam will exert on a square inch of surface in the boiler. Thus, if it is estimated to work with steam of 1 lb. on

the inch, the cistern must be raised 3 feet; if 2 inches, 6 feet; 3 inches, 9 feet; and so on. If the steam is by any chance raised higher than the height of the cistern provides for, the whole of the water in the boiler may be forced up through the pipe into the cistern, or until the lower orifice of the pipe, within the boiler, is exposed to the steam which will then also be ejected through the pipe; and the boiler may be left dry. Such an accident, however, cannot occur to the extent here described, if the feeding apparatus is in proper working order; and its occurrence to any extent is sufficiently guarded against by a safety-valve.

(1602). The safety-valve of the steam-boiler is usually a conical metal valve, and always opening outward; it ought always to be of a diameter large in proportion to the size of boiler and steam-pipe, so as to insure the free egress of any rapid generation of steam. For a boiler of the size under consideration it should be 2 inches in diameter on its under surface—that being the surface acted upon—this gives an area of fully 3 square inches; and if loaded directly, or without the intervention of a lever, for steam of a pressure of 1 lb. on the inch, it will require 3 lb.; if 2 lb. on the inch, 6 lb.; if 3 lb. on the inch, 9 lb., and so on. With these adjustments, the steam, should it rise above the proposed pressure, will, instead of forcing the water through the feed-pipe, raise the safety-valve, and escape into the atmosphere until the pressure is reduced to the intended equilibrium.

(1603.) Another precautionary measure in the use of the steam-boiler is the gauge-cock, of which there are usually two, but sometimes one, a two-way cock; they are the common stop-cock, with a lengthened tail passing downward, the one having its tail terminating about 1½ inch below the proper water level in the boiler, the other terminating 1½ inch above that level, which allows a range of 3 inches for the surface of the water to rise or fall. The first, or water-cock, then, when opened, will throw out water by the pressure of the steam upon its surface, until the surface has sunk 1½ inch below its *proper* level, when steam will be discharged, thus indicating the water in the boiler to be too low, and that measures should be taken to increase the supply. When the second, or steam-cock is opened, it will always discharge steam alone, unless the water shall have risen so high as to come above its orifice, in which case the cock will discharge *water*, indicating a too large supply of water to the boiler, and that it should be reduced; for this purpose, the feed-pipe *i* is provided with a stop-cock *m*, whereby the admission of water can be entirely prevented at the pleasure of the attendant.

(1604.) The foregoing description refers to a steaming apparatus of the best description, and implies that the water-cistern can be supplied either from a fountain-head, or that water can be pumped up to the cistern. But there may be cases where neither of these are easily attainable. Under such circumstances the feed-pipe may rise to the height of 4 or 4½ feet, and be surmounted by a funnel, and under it a stop-cock. In this case, also, a float with a wire stem, rising through a stuffing-box on the top of the boiler, must be employed—the stem may rise a few inches above the stuffing-box, in front of a graduated scale—having the zero in its middle point. When the water is at the proper height in the boiler, the top of the stem should point at zero, and any rise or fall in the water will be indicated accordingly by the position of the stem. To supply a boiler mounted after this fashion, the first thing to be attended to, before setting the fire, is to fill up the boiler, through the funnel, to the proper level, which

will be indicated by the float pointing to zero ; but it should be raised, in this case, two or three inches higher. In this stage, the gauge-cocks are noneffective ; but when the steam has been got up, they, as well as the float, must be consulted frequently ; and should the water, by evaporation, fall so low as 3 inches below zero, a supply must be introduced through the funnel. To effect a supply, in these circumstances, the steam must be allowed to fall rather low, and the funnel being filled, and the stop-cock opened, the water in the former will sink down through the tube, provided the steam be sufficiently low to admit its entrance, but the first portion of water that can be thus thrown in will go far to effect this, by sinking the temperature. The sinking of the temperature by the addition of a large quantity of cold water, is the objection to this mode of feeding ; but this is obviated to some extent from the circumstance, that unless the steaming receptacles are large or numerous, the first charge of water will generally serve to cook the mess, when a fresh charge can be put in for the next.

(1605.) In using this steaming apparatus, it has been noticed that the casks are furnished with gudgeons, which play in the posts *n n* ; these are kept in position by the collar-beam *o* to which they are attached ; the casks being at liberty to be tilted upon these gudgeons. They are charged when in the upright position, and the connection being formed with the steam-pipe, as described, they are covered at top with a close lid or a thick cloth, and the process goes on. When the substances are sufficiently cooked, the couplings *r r* are disengaged, the upper part of the cask is swung forward, and their contents discharged into a trough which is brought in front of them for that purpose.

(1606.) The connections with the steam-pipe are sometimes, for cheapness, formed by a *sliding tube* of copper or brass, about 4 inches in length, which, after the nozzle of the cask and that projecting from the steam-pipe are brought directly opposite to each other, is slid over the junction, and as a moderate degree of tightness only is requisite in such joints, a strip of sacking wrapped round the ends of the slider is found sufficient. On breaking the connection, and opening the exit nozzles, the steam will of course flow out, but this is checked by a wooden plug, or even a potato or slice of turnip, thrust into the orifice, may be sufficient. It is advisable, however, that a main stop-cock should be placed in the steam-pipe any where between the boiler and the first receptacle.

(1607.) The most perfect mode of connection between the steam-pipe and the receptacles is a *stop-cock and coupling-screw*. These should be of $1\frac{1}{2}$ inch bore, they are more certain in their effect, and more convenient in their application, though attended with more expense in the first cost of the apparatus. In this case no main-cock is required. The extremity of the steam-pipe should, in all cases, be closed by a small stop-cock, for the purpose of draining off any water that may collect in the pipe from condensation. A precaution to the same effect is requisite, in the bottom of each cask, to draw off the water that condenses abundantly in it ; or a few small perforations in the bottom will effect the purpose.

(1608.) It must be remarked, in regard to steaming, that in those establishments where grain of any kind is given in food in a cooked state, that dry grain cannot be cooked, or at least boiled to softness in dry steam, the only effect produced being a species of parching ; and if steam of high temperature is employed, the parching is increased nearly to carbonization. If it is wished, therefore, to boil grain by steam, it must be done by one of the two following methods.

The grain must either be soaked in water for a few hours, and then exposed to the direct action of the steam in the receptacle; or it may be put into the receptacle with as much water as will cover it, and then, by attaching the receptacle to the steam-pipe, by the coupling stop-cock, or in the absence of stop-cocks, by passing a bent leaden pipe from the steam-pipe, over the upper edge of the receptacle and descending again inside, to the space between the false and the true bottoms; the steam discharged thus, by either method, will shortly raise the temperature of the water to the boiling point, and produce the desired effect.*

(1609.) The time required to prepare food in this way varies considerably, according to the state of the apparatus, and the principle of its construction. With the apparatus just described, potatoes can be steamed in casks of from 32 to 50 gallons contents, in 30 to 45 minutes. In casks extending to 80 gallons, an hour or more may be required. Turnips require considerably longer time to become fully ready, especially if subjected to the process in thick masses, the time may be stated at double that of potatoes. When the apparatus is ill constructed, the time, in some cases, required to cook turnips, extends to 5 hours. And, with reference to the apparatus first described (1600.), the time is seldom under 5 hours.

(1610.) The prices of steaming apparatus vary according to quality and extent; but, on an average, the open boiler and pan apparatus, including a power-crane, will range from L.7 to L.10; and of the other, fig. 290, the price ranges from L.8 to L.16. The expense of building the furnace, and supplying mixing troughs, will add about L.2, 10s. to each.

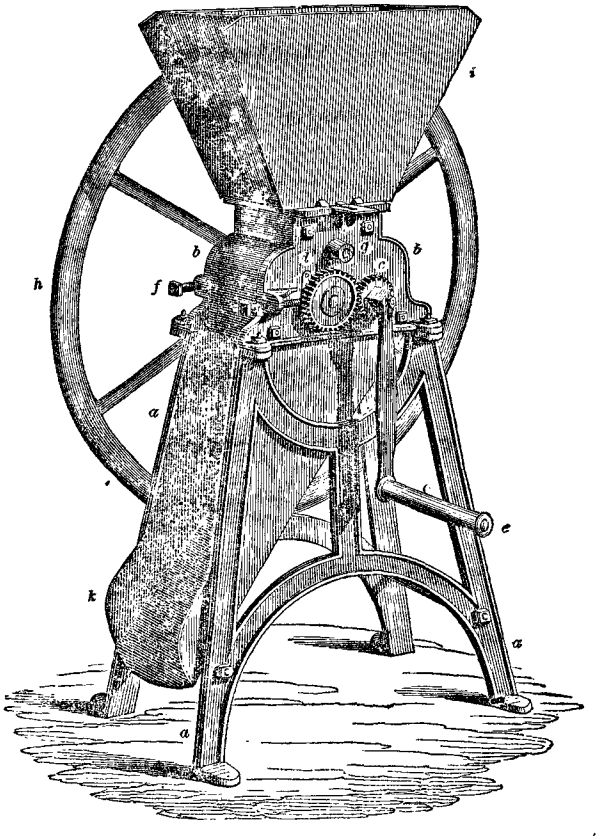
(1611.) *Corn Bruisers.*—In following up an economical system of feeding, the bruising of all grain so applied, forms an important branch of the system, and, as might be expected, numerous are the varieties of machines applied to the purpose. These naturally arrange themselves under *three* distinct kinds. 1*st*, Machines which act on a principle that partakes of cutting and bruising, by means of grooved metal cylinders, and is applied to those chiefly driven by the hand. 2*d*, Machines adapted to bruise only by means of smooth cylinders; this is applied exclusively to those driven by steam, or other agency more powerful than the human hand. And, 3*d*, Breaking or grinding by the common grain millstones, and, of course, only worked by power.

(1612.) That variety of the first division which I shall particularly notice, is represented in perspective in fig. 291. It is constructed almost entirely of cast-iron, except the hopper and discharging-spout; but its frame or standard may with propriety be formed of hardwood, when circumstances render the adoption of that material desirable. In the figure, *a a a* is the frame-work, consisting of two separate sides, connected by two stretcher-bolts, the screw-nuts of which are only seen near to *a* and *a* below. A case *b b*, formed of cast-iron plates, is bolted upon the projecting ears at the top of the frame, and contains the bruising cylinders. The cylinders are 4 inches in diameter, and 6 inches in length, of cast-iron or of steel. They have an axle of malleable iron passing through them, having turned journals, which run in bearings formed on the cast-iron side-plates of the case, the bearings being accurately bored out to fit the journals. The spur-wheels *c* and *d* are fitted upon the axle of the cylinders, *c* hav-

* See an article by me in the Quarterly Journal of Agriculture, vol. vi. p. 33.

ing 14 teeth, and *d* 24 teeth. The cylinder corresponding to *d* is perfectly smooth, while that of *c* is grooved at a pitch of $\frac{1}{4}$ inch, and about $\frac{5}{32}$ inch deep, worked to sharp edges. The grooves lie obliquely on the face of the cylinder, being at an angle of 10° with the axis. The winch-handle *e* is attached to the axle of the roller *c*, whose bearings are permanent, while those of *d* are mov-

Fig. 291.

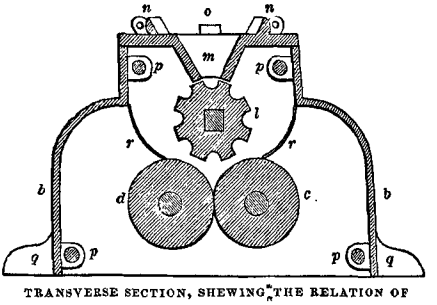


THE HAND CORN-BRUISER.

able, being formed in separate plates, and fitted to slide to a small extent in a seat, for the adjustment of the cylinder to any desired grist. This adjustment is effected by means of the screws *f*, which act upon the sliding-plates of the bearings. *g* is one of the bearings of a feeding-roller, placed also within the case; it is turned by means of a toothed-wheel fitted upon the further end of its axle, and which is driven by another wheel of 24 teeth on the axle of the cylinder *d*. The fly-wheel *h* is fitted upon the axle of the cylinder *c*, and is $3\frac{1}{2}$ feet in diameter; *i* is the feeding-hopper, attached to the top of the case by two small hooks; and *k* is a wooden spout to convey the bruised grain from the case.

(1613.) Fig. 292 is a section of the case, and the cylinders, detached from the frame. *b b* are the two ends of the case cut by the section; *c* is the grooved cylinder, *d* the smooth, and *l* is the feeding-roller, it is $3\frac{1}{2}$ inches diameter, and has cylindrical grooves formed on its surface to convey the grain; *o* is a cover of cast-iron fixed upon the top of the case; it has two round ears *n n*, with eyeholes which serve to steady the hopper, and to which it is screwed by the hooks already mentioned. A hopper-shaped opening *m* is formed in the cover; it is 6 inches long, 3 inches wide at top, and 1 inch at bottom, and the edges fit closely upon the feeding-rollers. Two plate-iron sliders are fitted upon the surface of this little hopper, which serve to enlarge or contract the opening longitudinally, and are fixed by screw-bolts in each plate; the head of one of the bolts is seen at *o*. *p p p p* are ears by which the case is bolted together, and *q q* are prolongations of the side-plate of the case; *r r* are additional plates of sheet-iron, to prevent the grain from being thrown over the cylinders unbruised.

Fig. 292.



TRANSVERSE SECTION, SHEWING THE RELATION OF THE PRINCIPAL PARTS.

(1614.) This is a very efficient machine for bruising either oats or beans; the adjustment of the plain cylinder to the requisite distance being easily accomplished by the adjusting screws; and to prevent the abrasion of the grooved cylinder, by coming in too close contact with the other, a stopper is applied on each side, to keep the slides from overreaching the due safety distance. From the different velocities of the two cylinders, the grooved one being the fastest, it produces a cutting as well as a bruising action, which renders its effects on the grain more perfect than simple pressure. It can be worked by one man, who will bruise 4 bushels of oats in an hour. The price of the machine is L.6, 10s.

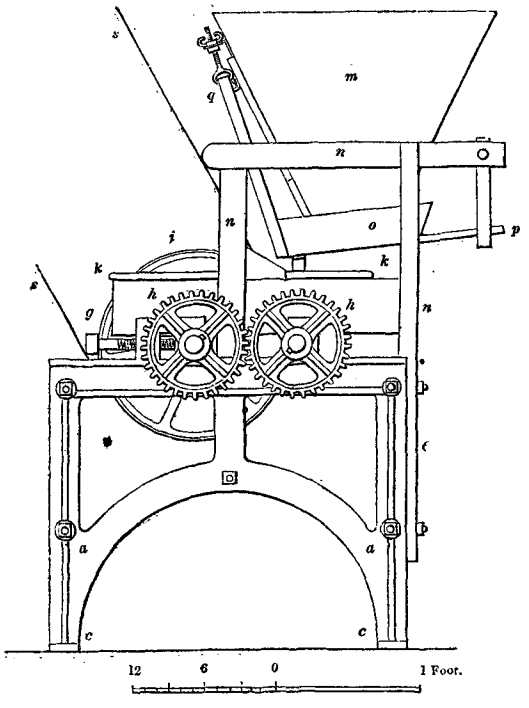
(1615.) Various other forms of this machine are in use, some with both cylinders grooved, others with only one grooved cylinder acting against a grooved plate; in this last state it is much used for bruising beans.

(1616.) Amongst the varieties of the bruising machine of the 2d division, I may just notice one that is found very efficient. It consists of two plain-edged wheels or pulleys, as they may be termed, usually about 6 inches broad on the rim or sole; the one ranges from $2\frac{1}{2}$ feet to 4 feet in diameter, and its fellow only half the diameter of the larger. They require to be truly turned on the rim, and work in contact. The smaller one is always driven by the power, and the larger usually by contact with the smaller. The smaller wheel makes, according to its diameter, from 150 to 200 revolutions per minute. Where plain cylinders are employed for bruising, and their surfaces moving with equal velocity, the effect is to press each grain into a flat hard cake; but when one of the surfaces is left at liberty to move by simple contact, it is found that the effect is different from the above, for the grain passes, bruised indeed, though not into a hard cake, but has apparently undergone a species of tearing, leaving it in a more open and friable state than as described above. This machine, however, does not answer well for bruising beans, for here, again, they come through in the form of a flat cake.

If beans, therefore, are used in an establishment where this bruiser is adopted, a separate one, on the principle of fig. 291, is required for the beans alone; that machine, though serviceable for a small establishment, being incapable, even with power, to produce the quantity in a reasonable time that would be required in a large one.

(1617.) *Plain Roller Corn-bruisers, for power.*—A very efficient corn-bruiser, adapted for power, is shewn in figs. 293, 294, 295. The first being an eleva-

Fig. 293.

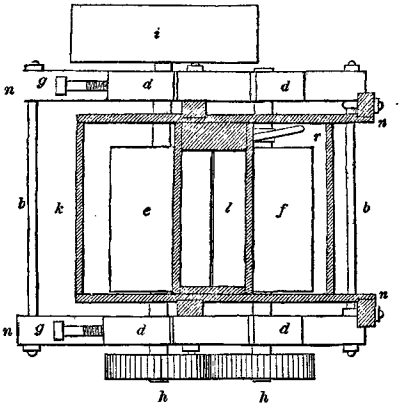


THE ELEVATION OF THE POWER CORN-BRUISER.

tion, the second a plan, and the third a section of the machine; the same letters apply to such corresponding parts as are seen in all the three figures. In fig. 293 *a a* is one of the side frames, of cast iron, which are connected together by stretcher-bolts *b*, and the frame so formed is bolted to a floor through the palms at *c c*. On the top bar of the frames there are two strong snugs *d d* cast, sufficient to resist the pressure of the rollers, and are formed also to receive the brass bushes in which the journals of the two rollers are made to run. The two rollers *e* and *f* are respectively 8 and 9½ inches diameter, and are 18 inches in length, fitted with malleable iron shafts 1¾ inch diameter; the roller *f* runs in permanent bearings, but *e* has its bushes movable, for adjustment to the degree of bruising required, and this adjustment is effected by the adjusting screws *g*. The shaft of each roller carries a wheel *h*, equal in dia-

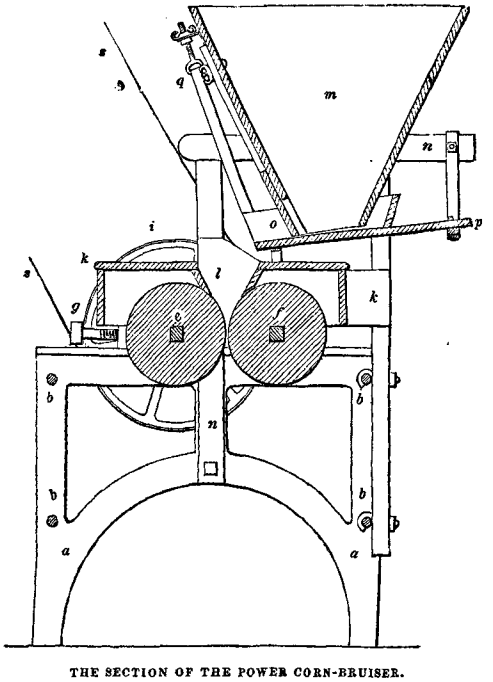
meter, which is 9 inches. The roller *e* has also upon its shaft the driving-pulley *i*, which by means of a belt *s s* from any shaft of a thrashing-machine or other power having a proper velocity, puts the rollers in motion. The rollers are inclosed in a square wooden case *k k*, in the cover of which a narrow hopper-shaped opening *l* is formed to direct the grain between the rollers. A hopper *m* for receiving the grain is supported on the light wooden frame-worked *n n*, which also supports the feeding-shoe *o*, jointed to the frame at *p*, and suspended by the straps *q*, which last is adjustable by a screw at *q* to regulate the quantity of feed. A smooth-edged oblique wheel *r*, fig. 294, is mounted on the shaft of the roller *f*, and by its oscillating revolutions, acting upon a forked arm which descends from the shoe, a vibratory motion is given to the latter, by which a regular and continued supply of the

Fig. 294.



THE PLAN OF THE POWER CORN-BRUISER.

Fig. 295.



THE SECTION OF THE POWER CORN-BRUISER.

grain is delivered from the hopper to the rollers. After passing the rollers the grain is received into a spout, which either delivers it on the same floor, or

through a close spout in the floor below. The velocity of the rollers, which are driven by the belt *s s*, may be 250 revolutions per minute. The dimensions of the frame *a* are 30 inches in length and 24 inches in height; the width over all being also 24 inches. The price of this machine, as manufactured by James Slight and Co., is L.10.—J. S.]

(1618.) The horse is an intelligent animal, and seems to delight in the society of man. It is remarked by those who have much to do with blood-horses, that, when at liberty, and seeing two or more people standing conversing together, they will approach, and seem, as it were, to wish to listen to the conversation. The farm-horse will not do this; but he is quite obedient to call, and distinguishes his name readily from that of his companion, and will not stir when desired to stand until *his own name* is pronounced. He distinguishes the various sorts of work he is put to, and will apply his strength and skill in the best way to effect his purpose, whether in the thrashing-mill, the cart, or the plough. He soon acquires a perfect sense of his work. I have seen a horse walk very steadily towards a feering pole, and halt when his head had reached it. He seems also to have a sense of time. I have heard another neigh almost daily about 10 minutes before the time of loosening in the evening, whether in summer or winter. He is capable of distinguishing the tones of the voice, whether spoken in anger or otherwise: and can even distinguish between musical notes. There was a work-horse of my own, when, even at his corn, would desist eating, and listen attentively, with pricked and moving ears and steady eyes, the instant he heard the note of low G sounded, and would continue to listen as long as it was sustained; and another, that was similarly affected by a particular high note. The recognition of the sound of the bugle by a trooper, and the excitement occasioned in the hunter when the pack give tongue, are familiar instances of the extraordinary effects of particular sounds on horses.

(1619.) When alluding to the names of horses, I may mention that they should be *short and emphatic*, not exceeding two syllables in length, for longer words are difficult of pronunciation, and inconvenient to utter when quick or sharp action is required of the horse; and a long name is almost always corrupted into a short one. For geldings, Tom, Brisk, Jolly, Tinker, Dragon, Dobbin, seem very good names; for mares, Peg, Rose, Jess, Molly, Beauty, Mettle, seem as good; and as to the names of stallions, they should be somewhat high-sounding, as indicative of greater importance of character, as Lofty, Farmer, Ploughboy, Matchem, Diamond, Blaze, Samson, Champion, which is the name of the black stallion pictured in Plate XVI., are names which have all distinguished first-rate draught horses.

(1620.) This seems a befitting place to say a few words on the farmer's *riding* and *harness* horses. Usually a young lad, a groom, is hired to take charge of these, to go errands and to the post-office, and otherwise make himself serviceable in the house. Sometimes the hedger or shepherd acts the part of groom. My shepherd acted as groom, and his art in grooming was so skilful, that many friends have remarked to me that they would be glad to see their *professed* grooms turn out a saddle-horse or gig in so good a style as he did. Besides being useful in carrying the farmer to market, or other short distances, a roadster is required to carry him over the farm when it is of large extent, and when the work-people necessarily receive pretty constant attention in the important operations of seed-time and harvest. The harness-horse is useful to a family at all times, as well as to the farmer himself, when he visits his friends;

and many farmers now prefer riding to market in a gig or drosky, to horseback; and it must be owned to be the pleasanter mode of the two.

(1621.) I have said that the agricultural pupil should have no horse of his own at first, to tempt him to leave home and neglect his own training. But to know how a riding-horse ought to be kept by a groom, and to be able to correct him when he neglects his duty or performs it in an unsatisfactory manner, I would advise him to undertake the charge of one himself for some time; not merely to superintend its keeping, but to clean it himself, to water and corn it at stated times at morning, noon, and night, and to keep the saddle and bridle in proper order. I groomed a new-broke-in blood filly for four months one winter, and got more insight into its form, temper, management, and wants, than I could have obtained by observation alone in a much longer time. On coming home at night from visiting a friend, I made it a point with myself to make my charge comfortable for the night before thinking of my own rest.

(1622.) A saddle-horse is treated somewhat differently in the stable from a work-horse. The first thing to be done early in the morning is to shake up the litter nearest the strand with a fork, removing the dung and soiled straw to a court-yard, and sweeping the floor clean. Then give the horse a drink out of the pail which is constantly kept full of water in the stable. The usual practice is to offer the water *immediately* before giving the corn; but I conceive it more conducive to the health of the horse to slake his thirst a while before giving him corn, the water by that time having reached its destined place, and acquired the temperature of the body. Should the horse have to undertake a longer journey than walking about the farm, a stinted allowance of water before starting on the journey is requisite, say to 10 gluts; but if he is to be at home, then he may drink as much as he pleases. He is then groomed by being, in the first place, gently gone over the whole body with the currycomb, to loosen any particles of mud that may possibly have been left adhering upon the hair from the former night's grooming, and also to raise the scurf from the skin. The whole body should then be wisped down with straw, to clear off all the dust and dirt that the currycomb may have raised to the surface. The brush follows, to clear the hair of its dust and scurf, the currycomb being used to clean the brush. Of wisping and brushing, wisping is the more beneficial to the legs, where the hair is short and the tendons and bones are but little covered, because it excites in them warmth, and cleans them sufficiently. Both wisping and brushing should be begun at the head and terminated at the other end of the body, along the lie of the hair, whichsoever way that may be, and which, notwithstanding its different swirls, all tends from the upper to the lower part of the body. Many a groom rests content with the brushing just mentioned; but it does not entirely remove the dust raised to the surface, and therefore a wisping is required to do it. The wisp for this purpose is best made of Russia mat, first wetted, and then beaten to softness, and rolled up somewhat firmly into the form of a wisp sufficient to fill the hand. A wisp of hair-cloth makes the skin clean, but in dry weather it is apt to excite such a degree of electricity in the hair of the horse, as to cause it to attract much dust towards it. On the horse being turned round in the stall, his head, neck, counter, and fore-legs, should be well rubbed down with this wisp, and this done, he should again be turned to his former position, and the body, quarters, and hind-legs, then rubbed down; and when all this has been accomplished, the horse may be considered clean. All this grooming implies the bestowal of much more labour than most farmers' riding-horses

receive. They are usually scuffled over in the morning with the currycomb, and then skimmed down with the brush, and with a hasty combing of the mane and tail, the job is considered finished. The mane and tail ought to be carefully combed out, and wetted over at the time of combing with a half-dry water-brush. The sheet should then be thrown over the horse, and fastened (not too tightly) with the roller. On putting on the sheet, it should be thrown more towards the head of the horse than where it is intended to remain, and from thence drawn gently *down the hair* with both hands, to its proper position, while standing behind the horse. The litter is then neatly shaken up with a fork, taking care to raise the straw so far up the travis on each side as to form a cushion for the side of the horse to rest against when he lies down. The feed of corn is then given him, and a little hay thrown into the rack; and on the stable-door being shut, he is permitted to enjoy his meal in peace. At midday, he should have another drink of water from the pail, the dung removed, the litter shaken up, and another portion of oats given him. At 8 o'clock at night, the sheet should again be taken off, the currycomb and brush used, and the entire dressing finished again with a wisping of the Russia mat. The sheet is then thrown over him as in the morning, the litter shaken up and augmented, water given, and the supper of oats, or a mash, finishes the day's treatment of the saddle-horse.

(1623.) The treatment just described is most strictly applicable to the horse remaining all day in the stable; but when he is ridden out, a somewhat different procedure is required. When he comes home from a long and dirty ride, the first thing is to get clear of the mud on the belly and legs. A very common practice is to wade the horse through the pond, as the farm-horses are, but such should not be the course pursued with a saddle-horse, because wading through a pond cannot thoroughly clear his legs of mud *to the skin*, he being clean-shanked and smooth-haired, and there still remains the belly to be cleaned by other means than wading. The plan is, being that adapted for winter, to bring the horse into the stable upon the pavement, and, on taking off the saddle and bridle and putting on a halter, scrape all the mud as clean off the belly and legs as can be done with a knife—a blunt table knife answers the purpose well. Then, with a pailful of lukewarm water, wash down *the legs*, outside and inside, with a water-brush, and then each foot separately, picking out the mud with the foot-picker; then wash the mud clean from the belly. A scrape with the back of the knife, after the washing, will bring out all the superfluous water from amongst the hair. On going into the stall the horse should be wisped firmly with straw, rubbing the belly first, and then both sides of each leg until they are all thoroughly dry. It is scarcely possible to get the belly dry at once, it should, therefore, get another good wisping with dry clean straw after the legs are dry. On combing out the mane and tail, putting on the sheet, and bedding plentifully with dry straw, the horse will be out of danger, and feel pretty comfortable even for the night; but should he have arrived some time before the evening time for grooming, the currycomb and wisp then applied will remove any moisture or dust that may have been overlooked before.

(1624.) Considerable apprehension is felt in regard to wetting the abdomen of horses, and especially at night, and the apprehension is not ill founded, for if the wet is allowed to remain, even to a small degree, quick evaporation ensues from the excited state of the body consequent on exercise, and rapidly reduces the temperature of the skin. The consequence of this coldness is irritation of the skin, and likely grease on the legs, and this is the danger of wetting the

bellies of farm-horses, and of any sort of horse, with *cold* water; for *warm* water cleans the hair and makes it dry sooner, even that on the abdomen, which is generally much longer than that of the legs; but, on the other hand, unless as much labour is bestowed as will dry the skin, and which is usually more than can be expected to be given by ordinary country grooms, it is safer for the horse to remain in a somewhat dirty state, than to run the risk of any inflammation by neglected wet limbs and abdomen. At the same time, if the requisite labour *shall* be bestowed to render the skin completely dry, there is even less risk in wetting the belly than the legs, inasmuch as the legs, in proportion to their magnitude, expose a much larger surface for evaporation, and are not so near the source of animal heat as the body.

(1625.) Saddle horses receive oats in proportion to the work they have to perform, but the least quantity that is supposed will keep them in such condition as to enable them to do a good day's work at any time, is three half-feeds a day, one in the morning, another at midday, and the third at night. When subjected to *daily* exercise, riding horses require 3 feeds a-day, and an extra allowance for extra work, such as a long journey. A mash once a-week, even when on work daily, is requisite; but when comparatively idle, a part of the mash, whenever prepared for the work-horses, may be administered with much advantage. I am no advocate of a bran-mash to a horse in good health, as it serves only to loosen the bowels without bestowing any nourishment. Boiled barley is far better. A riding-horse should have hay, and not straw, in winter; and he will eat from $\frac{1}{2}$ to $\frac{3}{4}$ of a stone of 22 lb. every day.

(1626.) On *cleaning harness* there should be two pairs of girths in use with the saddle, when the horse has much work to do, to allow each pair to be thoroughly cleaned and dried before being again used. The best way to clean girths is first to scrape off the mud with a knife, and then to wash them in *cold* water, and hang them up so as to dry *quickly*. *Warm* water makes them shrink rapidly, and so does long exposure to wet. If there is time, they should be washed in the same day they have been dirtied; but if not, on being scraped at night, they should be washed in the following morning, and hung up in the air to dry, and if the air is damp, let them be hung before the kitchen fire. Girths, allowed to dry with the mud on, soon become rotten and unsafe. The stirrup leathers should be taken off and sponged clean of the mud, and dried with a cloth. The stirrup-irons and bit should first be washed in water, and then rubbed dry with a cloth immediately after being used. *Fine* sand and water, on a thick woollen rag, clean these irons well, and a dry rub afterwards with a cloth makes them bright. Some smear them with oil on setting them past to prevent rust, but oil, on evaporation, leaves a resinous residuum to which dust readily adheres, and is not easily taken off afterwards. The curb-chain is best cleaned by washing in clean water, and then rubbed dry and bright by friction between the palms of both hands. The saddle-flaps should be sponged clean of mud, and the seat sponged with a wrung sponge, and rubbed dry with a cloth. Carriage harness should be sponged clean of mud, kept soft and pliable with fine oil, and, when not japanned, blackened with the best shoe black. There should be no plating or brass on a farmer's harness; plain iron japanned, or iron covered with leather, forming the neatest, most easily kept, and serviceable mounting. Bright metallic mountings of every kind soon assume the garb of the shabby genteel in the hands of an ordinary rustic groom.

(1627.) I have not thought it worth while to give a figure of the currycomb

and other small implements of the stable, as they are so well known; but the prices of a few of such articles may be useful. Currycombs range from 8d. to 1s. 6d.; brush, 3s. 6d.; mane-comb, 6d.; foot-picker, to fold in the pocket, 1s. 6d.; shears, 5d. to 1s. 4d.; plain nose-bags for farm-horses, 1s. 6d., with leather bottom, 7s. each. I omitted to mention the price of the cattle-probang in (1513.), fig. 271. It is 5 feet 1 inch in length, $\frac{3}{4}$ inch in diameter; pewter cup and ball ends, $1\frac{1}{2}$ inch diameter. Mouth-piece, 5 inches long and 3 inches wide, with two handles 5 inches long each. Price of the probang itself, 12s., and with mouth-piece, 14s. The trochar, fig. 272, is 5 inches long in the spear, with a handle 4 inches, and price 3s. 6d.

(1628.) I have never heard of farm-horses having their coats *clipped*. The effects likely to arise from this operation may be collected from these observations of a veterinary surgeon, though not applied by him to farm-horses. "If the owner," says he, "cannot suffer a long coat of hair, and will have it shortened, he must never allow the horse to be motionless while he is wet or exposed to a cold blast. He must have a good groom and a good stable. Those who have both, seldom have a horse that requires clipping, but, when clipped, he must not want either. A long coat takes up a deal of moisture, and is difficult to dry; but whether wet or dry, it affords some defence to the skin, which is laid bare to every breath of air when deprived of its natural covering. Every one must know from himself whether wet clothing and a wet skin, or no clothing and a wet skin, is the most disagreeable and dangerous. It is true that clipping saves the groom a great deal of labour. He can dry the horse in half the time, and with less than half the exertion which a long coat requires; but it makes his attention and activity more necessary, for the horse is almost sure to catch cold, if not dressed immediately. When well clothed with hair, he is in less danger, and not so much dependent upon the care of his groom."* These observations contain the whole rationale of clipping, and shew that it is inapplicable to farm-horses, and, as country grooms are usually qualified, clipping would prove but a problematical good to the saddle or harness horse of the farmer.

(1629.) In regard to the *diseases* of the horse, if we were to regard in a serious light the list of frightful maladies incident to that animal, which every work on veterinary science contains, we would never purchase a horse; but fortunately for the farmer, his horses are exempt from a large proportion of those maladies, as almost every one relating to the foot, and their consequences, are unknown to them. Nevertheless, many serious and fatal disorders do overtake farm-horses in their usual work, with the symptoms of which you should be so far acquainted as to recognise the nature of the disease; and as you should be able to perform some of the simpler operations to assist the animal in serious cases until the arrival of the veterinary surgeon, a short account of these operations may prove useful. One or more of them, when timely exercised, may have the effect of soon removing the symptoms of less serious complaints. They consist of bleeding, giving physic and drenches, applying fomentations, poultices, injections, and the like.

(1630.) *Bleeding.*—"In the horse and cattle, sheep and dog, bleeding, from its greater facility and rapidity," says Professor Dick, "is best performed in the jugular or neck vein, though it may also be satisfactorily performed in the *plate* and *saphena* veins, the former coming from the inside of the arm, and

* Stewart's Stable Economy, p. 120.

running up directly in front of it to the jugular; the latter, or thigh-vein, running across the inside of that limb. Either the fleam or lancet may be used. When blood is to be drawn, the animal is blindfolded on the side to be operated upon, and the head held to the other side; the hair is smoothed along the course of the vein by the moistened finger, the point selected being about 2 inches below the angle of the jaw. The progress of the blood toward the heart is to be obstructed, and the vein thus made sufficiently permanent and tense. A large-bladed fleam, and a good-sized lancet, are preferable, as the benefit of the operation is much increased by the rapidity with which the blood is drawn. From 8 to 10 pints imperial is a moderate bleeding for the horse and ox, regulated in some degree by the size. From 12 to 16 or even 20 pints is a large one; and sometimes, in skilful hands, it is expedient to bleed till fainting is induced, and the animal drops down under the operation. The vessel in which the blood is received should be such that the quantity can be readily ascertained. When this is sufficient, the edges of the wound are to be brought *accurately together*, and kept so, by a *small sharp pin* being passed through them, and retained by a little tow. It is of importance, in closing the wound, to see it *quite close*, and that *no hairs or other foreign bodies* interpose. For a time the head should be tied up, and care taken that the horse does not injure the part."

(1631.) The dangers arising from carelessness in blood-letting are not numerous; and "the first of which, though it may alarm the inexperienced, is very trifling. It is a globular swelling, *thrombus*, sometimes as large as the fist, arising immediately around the new-made incision. The filtrating of the blood from the vein into the cellular membrane, which is the cause of the disease, is rarely very copious. Gentle pressure may be used at first, and should be maintained with a well-applied sponge and bandage, kept cool with cold lotion. Occasionally there is *inflammation of the jugular* from bleeding. . . . The cause is usually referred to the use of a foul fleam, or from allowing hairs to interfere with the accurate adjustment of the edges of the wound. The first appearance indicative of the disease is a separation of the cut edges of the integuments, which become red and somewhat inverted. Suppuration soon follows, and the surrounding skin appears tumefied, tight, and hard, and the vein itself, above the orifice, feels like a hard cord. After this the swelling of the neck increases, accompanied with extreme tenderness, and now there is constitutional irritation, with tendency to inflammatory fever. . . . In the first stage we must try to relieve by evaporating lotions or by fomentation. If these fail, and as soon as the disease begins to spread in the vein, the appropriate remedy is to touch the spot with the actual cautery, simply to sear the lips of the wound, and apply a blister over it, which may be repeated. Purgatives in full doses must be administered, and the neck, as much as possible, kept steady and upright."

(1632.) *Blistering.*—"Blistering plasters are never applied to horses. An ointment is always used, of which rather more than half is well rubbed into the part to be blistered, while the remainder is thinly and equally spread over the part that has been rubbed. When there is any danger of the ointment running, and acting upon places that should not be blistered, they must be covered with a stiff ointment made of hog's-lard and bees'-wax, or kept wet with a little water. . . . The horse's head must be secured in such a way that he cannot reach the blister with his teeth. . . . When the blister has become quite dry, the head may be freed. Sometimes it remains itchy, and the horse rubs it; in that case he must be tied up again. . . . When the blister is quite

dry, put some sweet-oil on it, and repeat it every second day. Give time and no work, otherwise the horse may be blemished by the process."

(1633.) *Physicing.*—" Physicing, which, in stable language, is the term used for purging, is employed for improving the condition when in indifferent health, and as a remedy for disease. The medicines chiefly used are, for *horses* Barbadoes aloes, dose from 3 to 9 drachms; croton *bean*, from 1 scruple to ½ drachm, or *cake*, from ½ drachm to 1 drachm, to which may occasionally be added calomel, from 1 to 1½ drachm. For *cattle*, aloes, in doses somewhat larger than for the horse; Epsom salts, or common salt, dose from 1 lb. to 1½ lb., with some stimulus, as ginger, anise, or carraway-seed; also linseed-oil, dose 1 lb., and croton-oil, 15 to 20 drops, or the bean or cake, the same as in the horse. For *dogs*, jalap, dose 1 drachm, combined with 2 grains of calomel; croton oil, dose 2 drops; bean, 5 grains; and syrup of buckthorn, dose 1 oz. These, it will be observed, are average doses for full-grown animals; in the young and small they may be less, in the large they may require to be greater; but much injury has often been done by too large doses too frequently repeated. To the *horse*, physic is usually administered in the form of a bolus or *ball;* to *cattle* by drinking or *drenching*, though for both either way may be employed. A ball is conveniently made of linseed meal, molasses, and the active ingredient, whether purgative, diuretic, or cordial; it should be softish, and about the size of a pullet's egg. In administering it, the operator stands before the horse, which is generally unbound, and turned with its head out of the stall, with a halter on it. An assistant stands on the left side, to steady the horse's head, and keep it from rising too high; sometimes he holds the mouth, and grooms generally need such aid. The operator seizes the horse's tongue in his left hand, draws it a little out and to one side, and places his little finger fast upon the under jaw; with his right hand he carries the ball smartly along the roof of the mouth, and leaves it at the root of the tongue; the mouth is closed, and the head is held, till the ball is seen descending the gullet on the left side. When loath to swallow, a little water may be offered, and it will carry the ball before it. A hot, troublesome horse should be sent at once to a veterinary surgeon. Instruments should, if possible, be avoided, and adding croton farina to the mash often answers the purpose." *Drenches* should be given with caution either to horse or ox; " that no unnecessary force be used, that they be never given by the nostrils, and especially that, if the slightest irritation is occasioned in the windpipe, the animal shall immediately be set at liberty, that, by coughing, he may free himself of the offending matter." " The horse must undergo *preparation for physic*, which is done by gently relaxing the bowels. During the day previous, his food should be restricted to bran mashes, a ¼ peck being sufficient for a feed, and this, with his drink, should be given warm; corn should be withheld, and hay restricted. He may have walking and trotting exercise morning and evening. The physic is given on an empty stomach early in the morning; immediately after, a bran-mash is given; that over, the horse goes to exercise for perhaps an hour, and is watered when he returns. The water should be as warm as he will take it; and he should have as much as he pleases throughout the day; bran-mash should be given as often as corn usually is, and better warm than cold; if both are refused, bran may be tried, but no corn, and but little hay. Sometimes gentle exercise may be given in the afternoon, and also next day. The physic usually begins to operate next morning, though it rarely takes effect in 12 hours, frequently not for 30. When the physic be-

gins to operate, the horse should stand in the stable till it *sets*, which may be in 12 hours." * The stable should be well littered behind the stall, to receive the discharge. "Many practitioners and horse-proprietors," says Mr Youatt, "have a great objection to the administration of medicines in the form of drinks. . . . There are some medicines, however, which must be given in the form of drink, as in colic. . . . An ox' horn, the larger end being cut slantingly, is the usual and best instrument for administering drinks. The noose of a halter is introduced into the mouth, and then, by means of a stable-fork, the head is elevated by an assistant considerably higher than for the delivery of a ball. The surgeon stands on a pail on the offside of the horse, and draws out the tongue with the left hand. He then, with the right hand, introduces the horn gently into the mouth and over the tongue, and, by a dexterous turn of the horn, empties the whole of the drink—not more than about 6 oz.—into the back part of the mouth. The horn is now quickly withdrawn, and the tongue loosened, and the greater portion of the fluid will be swallowed. A portion of it, however, will often be obstinately held in the mouth for a long time, and the head must be kept up until the whole is got rid of, which a quick, but not violent, slap on the muzzle, will generally compel the horse to do. The art of giving a drink consists in not putting too much in the horn at once; introducing the horn far enough into the mouth; and quickly turning and withdrawing it without bruising or wounding the mouth, the tongue being loosened at the same moment. A bottle is a disgraceful instrument to use, except it be a flat pint bottle, with a long and thick neck." † The nearside horn has the most handy twist for administering a drink with the right hand.

(1634.) *Fomentations.*—"Clean water is the best fomentation. It should be as hot as the hand can bear it, yet not hot enough to pain the animal. In fomenting the horse, the groom has rarely enough water, and he does not continue the bathing long enough to do any good. If the leg is to be fomented, get a pailful of water as hot as the hand can bear it; put the horse's foot into it, and, with a large sponge, lave the water well above the affected part, and keep it constantly running down the whole limb. Foment for half an hour, and keep the water hot by adding more."

(1635.) *Poultices.*—"Poultices should be formed of those materials which best maintain heat and moisture, and they should be applied as warm as possible, and can be safely borne. They are usually made of bran mash, turnips, or oatmeal porridge. Linseed meal alone makes the best of poultices, and some of it should always be added to the other ingredients. Wet bandages act as poultices."

(1636.) *Lotions.*—"Of *cooling* lotions, cold water is the menstruum. It may be made colder by the introduction of a little salt or ice. Sal ammoniac and vinegar may be added for the same purpose. The object is to reduce heat, and promote evaporation. The addition of a little spirits is made with the same object."

1637.) *The Pulse.*—"Of the *horse*, the natural pulse is from 35 to 45 beats in the minute; under fever, it rises to 80, 90, and 100. The most convenient spot to examine it is at the edge of the lower jaw, a little before the angle, where

* Dick's Manual of Veterinary Science, p. 8.

† Youatt on the Horse, p. 507, edition of 1842.

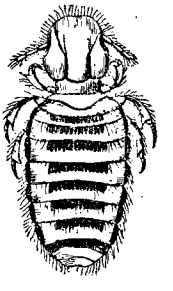
the maxillary comes from the neck to be distributed over the face. The pulse is one of the most important indications in all serious disorders."

(1638.) *Injections.*—"Injections, though easily administered by means of the old ox-bladder and pipe, are still more conveniently given with a syringe. For laxative clysters for the horse or cow, from 1 gallon to 12 pints imperial of warm water or gruel, at the temperature of 96° Fahr., with a couple of handfuls of salt or 2 oz. of soft soap, prove most useful. Stronger ones may be obtained by adding a few ounces of aloes to the mixture. In cases of diarrhœa or over-purging, the injection should consist of a few pints of warm gruel, to which is added 1 oz. of catechu electuary, or from ½ drachm to 1 drachm of powdered opium. The only art in administering a clyster,—where, however, there is often bungling, and even injury by wounding the rectum,—is *to avoid frightening the animal*, anointing the pipe well, and *gently* insinuating it *before the fluid is forced up*."

(1639.) "In general, bran mashes, carrots, green meat, and hay, form the sick horse's diet; gruel and tepid water his drink." * Of the diseases themselves, I shall only notice those at present which usually affect *farm*-horses in winter.

(1640.) *Horse-louse* (*Trichodectes equi*). The horse is infested by a louse as well as the ox, and which is represented in fig. 296. Colour of the head and thorax bright chestnut, the former very large and somewhat square, the surface with a longitudinal black line towards each side, forming an angle near the middle; antennæ with the third joint longest; abdomen pale, tawny yellow, with fine pubescence, the first eight segments having a dusky transverse band on the upper half, the lateral margins also with a dusky band; legs pale chesnut; length 1 line. Common in the tail-head and neck of the horse, especially when fresh from pasture in autumn. Found also on the ass. A little oil will destroy this animal when first established; but if allowed to remain on for some time, mercurial ointment will be necessary, but in small quantities at a time. The ass, however, has a louse peculiar to itself, the *Hematopinus asini;* of a rusty red; abdomen whitish, tinged with yellow, with a row of dark horny excrescences on each side; head long, with a deep sinuosity behind the antennæ; length 1 to 1¾ line. It frequents the mane and neck, and is common.†

Fig. 296.



THE HORSE-LOUSE, TRICHODECTES EQUI.

(1641.) *Batts.*—One of the most common complaints amongst farm-horses is the flatulent colic, gripes, or batts. It arises from indigestion, which again is occasioned by various causes, such as hard work immediately after feeding, drinking water largely after a feed of corn, bad state of the food, fast eating, and, in consequence, a paucity of saliva, an overloaded stomach, a sudden change of food from soft to hard and dry, and more likely to occur after eating turnips, potatoes, carrots, and grass, than hay and oats, and after pease than barley. The indigestion arises in two forms; the food either undergoing no change, or running rapidly

* Dick's Manual of Veterinary Science, p. 9.

† Denny's Monographia Anoplurorum Britanniæ.

to fermentation. In the former case, *acute foot-founder* is apt to arise, and its treatment is purgatives, drenches, and injections. In the latter case, the symptoms are most alarming. The horse falls down, rolls over, starts up, paws the ground with his fore foot, strikes his belly with the hind foot, perspiration runs down, and agony appears extreme. Relief may be obtained from this dose:—Linseed oil, raw, 1 lb.; oil of turpentine from 2 to 3 oz.; laudanum from 1 to 2 oz., or hartshorn from ½ oz. to 1 oz. The following tincture may be kept in readiness: In 2 lb. of whisky, digest for 8 days, 3 oz. of ginger, 3 oz. of cloves, and then add 4 oz. of sweet spirits of nitre. Half a pint imperial of this tincture is a dose, in a quart of warm water. The abdomen should be rubbed, the horse walked slowly about, and supplied with a good bed, and with room to roll about. If there is no relief in half an hour, a second dose may be given, and ere long, if still required, a third. Farm-horses that have keen appetites and devour their food greedily, and when they have been long in the yoke, are most apt to take this disease."

(1642.) *Inflammation of the bowels.* The symptoms of the batts are very similar at first to those of inflammation of the bowels, and, if mistaken, serious mistakes may arise, as the treatment of the two complaints is very different. The symptoms may be distinguished thus: In batts, the pulse remains nearly unaltered, whereas in inflammation it is quickened; all the extremities, the ears and feet, feel cold in batts, hot in inflammation. Whenever inflammation is apprehended, blood may be taken; in batts this is not necessary; but under such an apprehension, the assistance of the veterinary surgeon should be obtained as speedily as possible. I have cured many horses of the batts by administering stimulating drinks with a handy cow's horn. I remember of one horse being seized with inflammation of the bowels, on its arrival home from delivering corn at the market-town; and though the usual remedies of bleeding and blistering were resorted to, they proved ineffectual, no doubt from being disproportioned to the exigencies of the case, and the horse sunk in five days in excruciating agony. There was no veterinary surgeon in the district at that time, which was many years ago. Now, however, thanks to the Veterinary College of Edinburgh, through the really practically useful tuition of its indefatigable principal, Professor Dick, there is not a populous district of the country in which a skilful veterinarian is not settled. To the surgeon, therefore, in a serious case such as this—and, indeed, in all cases of extensive *inflammation*, and especially in the interior of the body—recourse should immediately be had. I say *immediately*, for it is but fair to give the surgeon the *chance* of treating the case correctly from its commencement, and not to impose upon him the task of amending your previous bungling. Inflammation of the *lungs*, as well as inflammation of the *kidneys*, both of which the farm-horse is subject to, should always be treated by the veterinarian; but fortunately, these formidable maladies may, almost with certainty, be evaded with well-timed working, discrimination of work according to the state of the weather, and by good food, supplied with regularity and in due quantity.

(1643.) *Common colds* frequently occur among farm-horses at the commencement of winter, and when not entirely unheeded, but treated with due care, seldom leave serious effects. "A cold requires nothing more but confinement in a moderately warm stable for a few days, with clothing, bran mashes instead of corn, and a little laxative and diuretic medicine." The evil lies not so much in the complaint itself, as in its ordinary treatment; it is seldom thought seriously

of by farmers—" it is *only* a cold," is the usual remark—and, in consequence, the horse goes out every day, feels fatigued, gets wet, becomes worse, and then the lungs not unfrequently become affected, or a chronic discharge is established from one of the nostrils. One season 9 horses out of 12 in one stable were affected, one after another, by a *catarrhal epidemic*, which required bleeding, poulticing, or blistering under the jaw, besides the medical remedies mentioned above. These I was obliged to take charge of myself, there being no veterinarian in the district, and all fortunately recovered. The remaining 3 were slightly affected afterwards, and easily brought through; but had the cases been unheeded from the first, very serious loss might have been incurred by death.

(1644.) *Grease.* " The well-known and unsightly disease called grease," says Professor Dick, " is a morbid secretion from the cutaneous pores of the heels and neighbouring parts, of a peculiar greasy offensive matter, attended with irritation and increased vascular action. It is most frequently seen in coach and cart horses, but often also in young colts which are badly cared for; and it is most common in the hind-feet, but occurs in all. Its main cause seems to be sudden changes in the condition of the foot from dry to wet, and from heat to cold, greatly augmented, of course, by evaporation." Hence the evil effects of washing the legs at night, without thoroughly drying them afterwards. " The first appearance of grease," continues the Professor, " is a dry state of the heels, with heat and itchiness. Swelling succeeds, with a tendency to lameness; the discharge augments in quantity, the hair begins to fall off. . . . In the early stage the parts should be washed with soap and water, and a solution of sugar of lead and sulphate of zinc applied; this may not be chemically scientific, but we have found it superior to any thing else. Even in old and aggravated cases it is very efficacious. . . . If the horse be strong and full of flesh, laxatives should be given, followed by diuretics; if weak, tonics may be added to these last. The feeding, too, must be varied with the condition:—green meat and carrots should be given, and mashes frequently, as a substitute for corn. During convalescence, exercise should be given, and bandages and pressure hasten the cure." I have no hesitation in saying that it is a disgrace for any steward, and in the want of such a functionary, it is so in the farmer himself, to allow his horses to become greasy. There is a complaint called a *shot of grease*, arising from a different cause from the common grease. " In the horse, plethora," says Professor Dick, " creates a strong disposition to inflammation of the eyes, feet, and lungs, and sometimes to an eruption which is called *surfeit*, or the *nettle-rash*. The hair falls off in patches, and the skin is raw and pimpled. There is also a tendency to *grease*, and to what has been designated a *weed* or *shot of grease* in the heavy draught-horse. One of the legs, generally a hind one, suddenly swells; the animal becomes lame; there is pain in the inside of the thigh; increased upon pressure; and fever supervenes. . . . We have seen it occur chiefly during continued rest after hard work and exposure to weather, in animals which were highly fed. The best treatment is large blood-letting, scarifying the limb, fomenting, and applying hay, straw, or flannel bandages, with purgatives and diuretics. The pressure of a bandage will expedite the reduction of the part to its natural dimensions."

(1645.) *Stomach staggers.* " The most prominent symptoms of this disease are the horse's hanging his head, or resting it on the manger, appearing drowsy, and refusing food; the mouth and eyes being tinged with a yellowish colour; there is twitching of the muscles of the chest, and the fore-legs appear suddenly to give way, though the horse seldom falls. Inflammation of lungs

or bowels, or lock-jaw, may supervene. Its cause is long fasting and over work; but the quality of the food acts as a cause. Its treatment is relieving the stomach and bowels with searching laxatives, such as croton, also aloes and calomel, with ginger. Clysters should also be given, and afterwards cordials. Bloodletting from the jugular vein will be attended with advantage. Finally, steady exercise and careful feeding will prevent a recurrence of the disorder."* I had a year-old draught-colt that was affected with this disease. He was a foul-feeding animal, delighting to eat the moistened litter from the stable and byre. He was bled and physicked by a veterinarian, who had established himself in the neighbourhood, and the front of his head blistered. He quite recovered, and having been removed from the temptation of foul feeding, he was never again similarly affected. The practice of keeping *he-goats* in the stables of inns, and of those persons who have extensive studs, is supposed, by the common people, to act as a *charm* against the mad staggers; but, as Marshall judiciously observes, the practice may be explained on physiological principles. "The staggers are a nervous disorder," he says, "and as odours, in many cases, operate beneficially on the human nerves, so may the strong scent of the goat have a similar effect on those of the horse. The subject," he adds, "is worthy of inquiry." † And he gives a striking instance of the good effects of the practice.

(1646.) *Thrush and Corns.* I have said that the feet of the farm-horse is not liable to so many diseases as those of horses subjected to high speed on hard roads. Farm-horses, however, are liable to *thrush* and *corns* in the feet. The former is situate at the hind part of the cleft of the frog, originating principally from continued application of moisture and dirt, and hence it may be most expected to be seen in dirty stables, of which there are not a few in the country. After being thoroughly cleaned out, the hollow may be filled with calomel, which generally cures; or with pledgets of tow dipped in warm tar, or spirit of tar, applied at night, and retained during the day. The general health of the horse should be attended to. *Corns* are usually the consequence of the irregular pressure of the shoe on peculiarly formed hoofs; and are mere bruises, generally produced by the heel of the shoe, and which, from the extravasated blood, assume a reddish or dark colour. They usually occur only in the fore-feet; and their site is almost invariably in the inner quarter between the bar and crust, at the heel. The obvious cure is removal of the pressure of the shoe.

(1647.) *Broken wind.* Besides natural complaints, farm-horses are liable, in the execution of their work, to accidents which may produce serious complaints. Thus over work, in a peculiar state of condition, may produce *broken wind*, which is the common phrase given to all disorganized affections of the lungs, though the term is defined by veterinarians to be "the rupture of some of the air-cells of the lungs, whereby air-vesicles are produced on the surface, and the expulsion of the air is rendered less direct and easy. It is usually produced by animals being urged to over-exertion when in bad condition, though a horse may become broken winded in a straw-yard." There are many degrees of broken wind, which receive appellations according to the noise emitted by the horse; and on this account he is called a piper, trumpeter, whistler, wheezer, roarer, highblower, grunter, and with thick wind, and with broken wind. I had two uncommonly good horses affected in the wind by working much in the

* Dick's Manual of Veterinary Science, p. 55.

† Marshall's Rural Economy of Gloucestershire, vol. ii. p. 34.

traces of a four-horse plough, which were employed to rip up old turf dykes intermixed with large stones, and to break up rough ground. These serious effects of such work gave me the hint to relinquish it, and take to the spade, which I soon found did the work much better, and in the end cheaper. The horses got gradually worse under the disease, and at length being unable to maintain their step with the rest, were disposed of as broken-winded horses.

(1648.) *Sprains.* "A sprain, or strain, is violence inflicted, with extension, often rupture and displacement, upon the soft parts of a joint, including cellular membrane, tendons, ligaments, and all other parts forming the articulation. The dislocation or disruption may be complete, or it may be a mere bruise or stress; and innumerable are the shades of difference between these extremes. Effusion of the fluids is an attendant consequence. Parts of vital importance, as in the neck or back, may be implicated, and the accident be immediately fatal, or wholly irremediable; on the contrary, they may be to that extent only, that, with time and ease, restoration may be accomplished. They constitute a serious class of cases. The marked symptoms are, pain in the injured parts, and inability of motion, sometimes complete. The treatment is at first rest, a regulation of the local action and constitutional disturbance, according to circumstances, by venesection, general and local, the antiphlogistic regimen, fomentation, bandages, and other soothing remedies; and when the sprain is of an older date, counter-irritation, friction, and gentle exercise." Farm-horses are not unfrequently subject to strains, especially in doing work connected with building, draining, and other heavy work; and they are most apt to occur in autumn, when geldings are generally in a weak state. For rough work of this kind old seasoned horses are best adapted, and such may often be procured for little money at sales of stock.

(1649.) *Saddle-galls.* When young horses are first put to work, the parts covered by the saddle and collar are apt to become tender, heated, and then inflamed, and if the inflammation is neglected, the parts may break out into sores. Washing with a strong solution of salt in water with tincture of myrrh, is a good lotion, while attention should be paid to the packing of both saddle and collar, until they assume the form of the horse intended to wear them. "Tumours, which sometimes result from the pressure of the saddle, go by the name of *warbles*, to which, when they ulcerate, the name of *sitfasts* is applied, from the callous skin which adheres to the centre. Goulard water may be used to disperse the swelling; a digestive ointment will remove the sitfast; and the *sore* should be healed with a solution of sulphate of zinc."

(1650.) *Crib-biting* and *wind-sucking.* These practices are said to increase the tendency to indigestion and colic, and to lower condition, rendering the horses which practise them unsound. "A crib-biter derives his name from seizing the manger, or some other fixture, with his teeth, arching his neck, and sucking in a quantity of air with a peculiar noise. . . . Wind-sucking consists in swallowing air, without fixing the mouth. The horse presses his lip against some hard body, arching his neck, and gathering together his feet." Both vices are said to be prevented by fastening a strap round the neck, studded with one or more sharp points or prickles opposite the lower jaw; but this means will not avail in all cases, for I had a year-old colt, who first began crib-biting in the field, by seizing the gate or any other object he could find. Being prevented using the gate by a few thorns, he pressed his mouth against any object that would resist him, even against the sides or rumps of his companions, and he then began to be a wind-sucker. A strap of the above form was put on,

recommended to me by an artillery officer; but though it remained upon the colt for more than a twelvemonth, night and day, and as tight as even to affect his appearance, he continued to crib-bite or wind-suck in spite of it, even to the laceration of his skin by the iron studs. Growing largely to the bone, though very thin, he was taken up to work at the early age of two years, solely with the view of seeing if the yoke would drive him from the practice, but it had no such effect. Whenever he came into the stable he set to with earnestness to bite and suck with the strap on, until he would become puffed up as if to bursting, and preferred sucking wind to eating his corn. At length I was so disgusted with the brute that I sold him to a carrier, to draw a heavy single cart, and got a fair price for him, though sold as a crib-biter.

(1651.) *Dust-ball.* Millers horses are most liable to be affected with this disease. It is composed of corn and barley-dust, saved in grinding meal, and used as food, and occurs sometimes in the stomach, but more frequently in the intestinal canal. "In an advanced stage, no doubt can remain as to the nature of the disorder. The countenance is haggard, the eye distressed, the back up, the belly distended, the respiration becomes hurried, bowels habitually costive, and sometimes the horse will sit like a dog on his haunches. Relief may frequently be afforded. Strong purgatives and large injections must be given, and under their continued action the offending body is sometimes removed." On using barley-dust, as food for horses, it would be well to mix it thoroughly with the other prepared ingredients, instead of using it in the dry state.

(1652.) *Worms.* Farm-horses are sometimes affected with worms. These are of 3 kinds; the round worm, *teres;* the thread-worm, *ascaris;* and the tape-worm, *tænia.* "In the horse the tænia is very rare; in the dog exceedingly common. When the horse is underfed his bowels are full of teres and ascaris; and the appearance of his staring coat, want of flesh, and voracious appetite, betoken it. They occasion gripes and diarrhœa, but the mischief they produce is not great. The principal habitat of the ascaris is the cœcum, although they are sometimes found in countless multitudes in the colon and rectum. Turpentine is a deadly poison to all these worms; but this medicine, so harmless in man, acts most disagreeably in the lower animals. Hence, it must not be given to them pure or in large quantities, but mixed in small proportion with other oils, as linseed, or in a pill; and, with these precautions, it may be found at once safe and efficacious."

(1653.) *Nebulæ,* or *Specks, in the Eye.* Farm-horses are not subject to the more violent diseases of the eye; but being liable to accidents, the effects of inflammation,—nebulæ, or specks,—do sometimes appear. "The former are superficial, the latter dip more deeply into the substance of the part. Directly in the sphere of vision, these, of course, impede it, and cause obscurity of vision. Even here we must proceed gently. These blemishes are the pure consequences of inflammation, and this subdued, their tendency is to disappear. Time and nature will do much, and the duty of the practitioner consists in helping forward the salutary process where necessary, by gently stimulating washes, whilst irritating powders should be avoided."* With these sensible remarks of Professor Dick, I shall conclude what I have to say of the diseases of the farm-horse at this time.

(1654.) The offals of the horse are not of great value. His *hide* is of most value when free of blemishes. It tans well, and forms a good leather, which, on

* Dick's Manual of Veterinary Science, p. 104.

being japanned, is chiefly used for covering carriages. I was informed by a friend who settled in Buenos Ayres as a merchant, that he once bought a lot of horses, containing no fewer than 20,000, for the sake of their hides alone, and that some of them would have fetched good prices in England. They were all captured with the *lasso*.

(1655.) *Horse hair* is used in the manufacture of damask-cloth for sofas and chair-bottoms. The dyeing of it of various beautiful colours, and the manufacture of the damask figures, have been much improved of late. Horse-hair is also used for making fishing lines, horse-tails for cavalry caps, and stuffing for mattresses, for which last purpose it is prepared by being wound up hard and baked in an oven.

(1656.) "Hair, of all animal products, is the least liable to spontaneous change. It can be dissolved in water only at a temperature somewhat above 230° Fahr. in Papin's digester, but it appears to be partially decomposed by this heat, since some sulphuretted hydrogen is disengaged. By dry distillation, hair gives off several sulphuretted gases, while the residuum contains sulphate of lime, common salt, much silica, and some oxides of iron and manganese. It is a remarkable fact that fair hair affords magnesia instead of these latter two oxides. Horse-hair yields about 12 per cent. of the phosphate of lime. Hair also yields a bituminous oil, which is black when the hair is black, and yellowish-red when the hair is red." *

(1657.) "Button moulds are made of the bones of the horse, ox, and sheep. The shavings, sawdust, and more minute fragments in making these moulds, are used by the manufacturers of cutlery and iron toys in the operation of case-hardening, so that not the smallest waste takes place." † The bones of all these animals, when reduced small, make the valuable manure—bone-dust—now well known to every farmer.

---

37. OF FATTENING, DRIVING, AND SLAUGHTERING SWINE.

> "Where oft the swine, from ambush warm and dry
> Bolt out, and scamper headlong to their sty."
>
> BLOOMFIELD.

(1658.) There should be no littering of young pigs in winter on an ordinary farm, because all young pigs are very susceptible of cold; and as chances of being exposed to it will frequently happen in the most comfortable sty, it is scarcely possible to avert its injuries; which are, reddening of the skin, causing the coat to stare, and if not actually killing the pigs, chilling them to such a degree as to prevent their growth until the return of more genial temperature in spring. If circumstances however, render it profitable to raise sucking pigs at Christmas,—and a roast pig at that joyous season is a favourite dish in England,—the matter may be accomplished as easily as the raising of house lamb at that

* Thomson's Animal Chemistry, p. 302.

† Ure's Dictionary of the Arts, arts. *Hair—Buttons.*

season, by having sties for the sows under a close roof, with doors and windows to shut out cold and admit light.

(1659.) But as few farms are so situate, the usual practice is the best, of refraining from the breeding of young pigs in winter, and of letting those pigs which are able to provide for themselves have the liberty of the courts; but still that liberty should be guarded with discretion. Of several litters on foot at the same time, the youngest should receive more nourishing food than the older; and the reason for giving them better treatment is founded on the general principle, that creatures when stinted of food, so long as they are growing to the bone, never attain the largest size of frame they are capable of. Those growing to be bone, until it is capable of carrying as much flesh as is most suited for the market, need not be fattened. Those which have attained that size of bone require but a short time to fatten into a *ripe* state. This mode of treatment, which delays their *fattening*, is peculiarly applicable to swine, which, having at all times a ready disposition to fatten, can be made to lay on *fat* almost to any degree, at any time, at any age, and upon any size of bone.

(1660.) That the youngest pigs may receive better treatment, the court and shed at *b*, fig. 3, Plate III., the same as in the plan at *b*, in fig. 4, Plate IV., and described in (68.), are made purposely for them. These pigs consist, probably, of the last litters of the season of as many brood sows as are kept. Here they should be provided daily with turnips as their staple food, of the sort given for the time to the cattle, and sliced as small as for sheep; and they should, besides, have a portion of the warm mash made for the horses, with such other pickings from the farm-house which the kitchen affords. They should also be provided with a trough of clean water, and plenty of litter under the shed every day. The court-yard should be cleaned out every day. Pigs are accused of dirty habits, but the fact is otherwise, and the accusation applies more truly to their owners who keep them dirty, than to the natural habits of the animals themselves. When constrained to lie amongst dirt, and eat food fit only for the dunghill, and even that dealt out with a grudging hand, how can they exhibit other than dirty propensities? But let them have room, choice of clean litter, and plenty of food, and it will soon be observed that they keep their litter clean, place their droppings in one corner of the court, and preserve their bodies free from dirt. It is the duty of the cattle-man to supply the store pigs with food, and clean out their court-yard, and this part of his duty should be conducted with as much regularity as the feeding of cattle. Whatever food or drink may be obtained from the farm-house is brought to the court by the dairymaid.

(1661.) The sties *c*, figs. 3 and 4, Plates III. and IV., are intended for sows about to litter. Whenever the period of their confinement approaches, each sow should be put into one of these, and supplied with food; but the treatment of sows will better fall to be described in spring. The form of door best suited for securing pigs in their sties, may be seen in fig. 23.

(1662.) The older pigs have the liberty of the large courts I and K, Plates III. and IV., where they make their litter amongst the cattle in the open court, when the weather is mild, and in the shed D, when it is cold. Though thus left at liberty, they should not be neglected of food, as is too often the case. They should have sliced turnips given them every day, in troughs, such as shewn in fig. 298, and they should also have troughs of water. Pigs, when not supplied with a sufficiency of food, will jump into the troughs of the cattle, and help themselves with turnips; but this dirtying of the cattle's food and troughs, they should be made to understand by coercion, is a practice not to be tolerated. The cattle-man attends upon these pigs, giving them sufficiency of turnips and water. An excellent form of trough, alluded to above, fitted to stand in the middle of a large court, and to contain the food of a number of pigs, is described below in fig. 298. It stands upon the dunghill, is not easily overturned, the cattle cannot hurt themselves upon it, and it keeps the food subdivided into a number of compartments; while it can easily be pushed about to the most convenient part of the court for supplying the food.

(1663.) It is seldom that farmers take the trouble of fattening pigs for the market, because, if the breed has a kindly disposition, the pigs are generally sufficiently fat for converting into pickled pork by the time they have attained the weight most desirable for that method of curing, namely, from 4 to 6 stones imperial. Dealers and butchers purchase porklings of those sizes, and finer meat of the kind cannot be obtained, than what is thus brought up at liberty in a farm-yard, being firm, sweet, tender, well proportioned in lean, and yet sufficiently fat for the table. Pork-curers buy from farmers and dealers in the carcass, and none alive. But the farmer should once a-year fatten a few pigs for his own use as ham. These should be *at least a-year old*, attain the weight of 18 or 20 stones, and be slaughtered about Christmas. Castrated males or spayed females are in the best state for this purpose; and are placed in such sties as at *a*, figs. 3 and 4, Plates III. and IV., and one in each stye. Four pigs of 20 stones each every year, will supply a pretty good allowance of ham to a farmer's family. Up to the time of being placed in these sties, the pigs have been treated as directed above; but when

confined, and intended to be *fattened to ripeness*, they receive the most nourishing food.

(1664.) By direct experiment, which will be found related below, it has been ascertained that pigs fatten much better on cooked than on raw food. This being the case, it is only waste of time and materials, and also loss of flesh, to attempt to *fatten* pigs on raw food of whatever kind; for although some sorts of food fatten better than others in the same state, yet the same sort when cooked fattens much faster and better than in a raw state. The question, therefore, simply is, what is the best sort of food to *cook* for the purpose of *fattening* pigs? Roots and grains of all kinds, when cooked, will fatten pigs. Potatoes, turnips, carrots, parsnips, as roots; and barley, oats, pease, beans, rice, Indian corn, as grain, will all fatten them when prepared. Which, then, of all these ingredients should be selected as the most nourishing, and, at the same time, most economical? Carrots and parsnips, amongst roots, are not easily attainable in this country, and therefore cannot be considered as economical food; and as to the other two sorts of roots, when cooked, potatoes doubtless contain much more nourishment than turnips, even in proportion to their price, for it is as easy to obtain 10s. for a ton of Swedish turnips, as 8s. for a boll of 40 stones of potatoes; and yet potatoes contain 4 times the nutritive matter of Swedes, and 6 times of common turnips.* Steamed potatoes, then, may form the staple ingredient of pig-feeding. As to grains, I have never heard of wheat or wheat-flour being given to pigs; it would certainly not be economical; barley or oat-meal being usually employed. Pease and beans, whether raw or cooked, are proverbially excellent food for pigs. And as to rice and Indian corn, they will both fatten well, if cooked. Amidst all these ingredients for choice, regarding the question of economy alone, it may be assumed that entire feeding on grain, of whatever kind, would be too expensive, so that, as steamed potatoes are of themselves nourishing food, a proportion, with any of the grains, should form a moderately-priced food which will ensure fatness. It has been ascertained in England, that upon 2 pecks of steamed potatoes, mixed with 9 lb. of barley-meal and a little salt, given every day to a pig weighing from 24 to 28 stones, will make it *ripe* fat in 9 weeks. Taking this proportion of food to weight of flesh as a basis of calculation, and assuming that 2 months will *fatten* a pig sufficiently well, provided it has all along received its food regularly and amply, I have no doubt that feeding with steamed potatoes and barley-meal, for the first month, and, in the second, with

* The Farmer's Almanac and Calendar for 1842, p. 22.

steamed potatoes and pease meal (both seasoned with a little salt), and lukewarm water, with a little oatmeal stirred in it, given by itself twice a day as a *drink*, will make any pig, from 15 to 30 stones, *ripe fat for hams*. The food should be given *at stated hours*, 3 times a-day, namely, in the morning, at noon, and at nightfall. One boiling of potatoes in the day, at any of the feeding-hours that is found most convenient, will suffice; and at the other hours, the boiled potatoes should be heated with a gruel made of barley or pease meal and boiling water; the mess being allowed to stand a while to incorporate and cool to blood heat. It should not be made so thin as to spill over the feeding trough, or so thick as to choke the animals; but of that consistence which a little time will soon let the feeder know the pigs relish best. Washing fattening pigs with warm water and soap rapidly promotes their fattening; and, after the first trial, they delight in the scrubbing. A convenient form of trough for fattening pigs is described below in fig. 297. The swing-door, on being fastened on the side nearest the pigs, serves the purpose of warding them off until the trough is cleaned out or replenished with food. The trough should be thoroughly cleaned every day, and being subdivided into three parts, more than one pig may be fattened in the same sty. But when only one occupies a sty,—which is the least troublesome arrangement,—one division may be filled with one of the meals daily, thus giving a clean trough every meal; and all the divisions should be cleaned in the morning, before supplying the first meal. After every meal is supplied, the swing-door is fastened nearest the outside, thus giving the pigs access to their food, as well as preventing them being disturbed at their meals. The quantity of food given at any time should be apportioned to the appetite of the animals fed, which should be ascertained by the person who feeds them; and it will be found that less food, in proportion to the weight of the animal, will be required as it becomes fatter. It is the duty of the dairy-maid to fatten the bacon-pigs, and that of the cattle-man to keep them clean and littered. When pigs are fattening, they lie, and rest, and sleep a great deal, no other creature shewing "love of ease" so strongly in all their motions; and, in truth, it is this indolence which is the best sign of their thriving condition. The opposite effects of activity and indolence on the condition of animals is thus contrasted by Liebig: "Excess of carbon," says he, "in the form of fat, is never seen in the Bedouin or in the Arab of the Desert, who exhibits with pride, to the traveller, his lean, muscular, sinewy limbs, altogether free from fat. But in prisons and jails, it appears as a puffiness in the inmates, fed as they are on a poor and scanty diet; it appears in the sedentary females of oriental countries; and, finally,

it is produced under the well known conditions of the fattening of domestic animals;"* and among these last, the pig may be instanced as the most remarkable.

(1665.) The denominations received by pigs are the following:— When new born, they are called *sucking pigs*, or simply *pigs*; and the male is called *boar pig*, the female *sow pig*. A castrated male, after it is weaned, is named a *shot* or *hog*. Hog is the name mostly used by naturalists, and very frequently by writers on agriculture; but as it sounds so like the name given to young sheep, I shall always use the terms pig and swine, for the sake of distinction. A spayed female is a *cut sow pig*. As long as both sorts of cut pigs are small and young, they get the name of *porkers* or *porklings*. A female that has not been cut, and before it bears young, gets the name of an *open sow*; and an entire male receives, and retains ever after, the name of *boar* or *brawn*. A cut boar is a *brawner*, and the flesh of both boar and brawner is *brawn*. A female that has taken the boar is said to be *lined*; when bearing young she is called a *brood sow*; and when she has brought forth pigs she is said to have *littered* or *farrowed*, and her family of pigs at one birth are called a *litter* or *farrow* of pigs.

(1666.) Of *judging* of a fat pig, the back should be nearly straight; and though arched *a little* from head to tail, it is no fault. The back should be uniformly broad and rounded across along the whole body. The touch all along the back should be firm but springy, the thinnest skin springing most. The shoulder, side, and hams should be deep up and down, and in a straight line from shoulder to ham. The closing behind should be filled up; the legs short, and bone small; the neck short, and thick, and deep; the cheeks rounded and well filled out; the face straight, nose fine, eyes bright, ears pricked, and the head small in proportion to the body. A curled tail is a favourite, because indicative of a strong back. All these characters may be observed in the figure of the brood sow in one of the Plates; though, of course, the sow is not in the fattened state. A black coloured pig is always black of skin, and a white one white, and which latter colour gives to the pig a cleaner appearance than the black. A *fat* pig ought never to be driven, but carried in a cart when desired to be transported from one place to another.

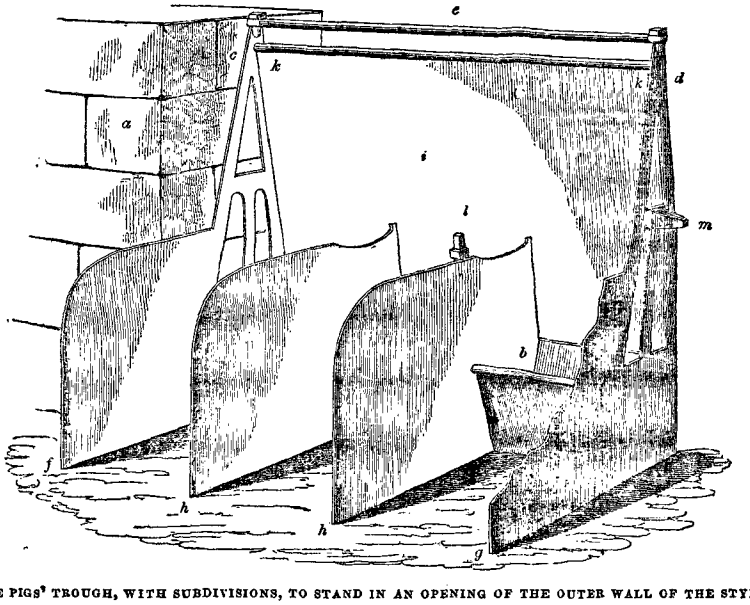
(1667.) As to the breed which shews the greatest disposition to fatten, together with a due proportion of lean, I never saw one to equal that which was originated by Lord Western, in Essex. I received a present of a young boar and sow of that breed from Lord Panmure, and had the breed for 10 years; and such was the high condition constantly

* Liebig's Animal Chemistry, p. 89.

maintained by the pigs on what they could pick up at the steading, besides the feed of turnips supplied them daily, that one could be killed at any time for the table, as a porkling. They were exceedingly gentle, indisposed to travel far, not very prolific, however, but could attain, if kept on, to a great weight; and so compact in form, and small of bone and offal, that they invariably yielded a greater weight of pork than was judged of before being slaughtered. Though the less valuable offal was small, the proportion of loose seam was always great, and more delicious ham was never cured in Westphalia than they afforded.

(1668.) [*Pigs' Troughs.*—A very convenient trough for a piggery has been long manufactured by the Shotts Iron Company, of which fig. 297 is a view in perspective from the interior of the court. It is nearly all made of cast-iron, and possesses the great convenience of allowing the troughs to be filled with food from the outside of the building, the feeder being at the same time free of any annoyance from the inmates. Troughs of this kind are placed in proper sized openings in the external wall of the piggery court, in the manner shewn in the figure, where *a* marks the wall on one side of the opening, that

Fig. 297.



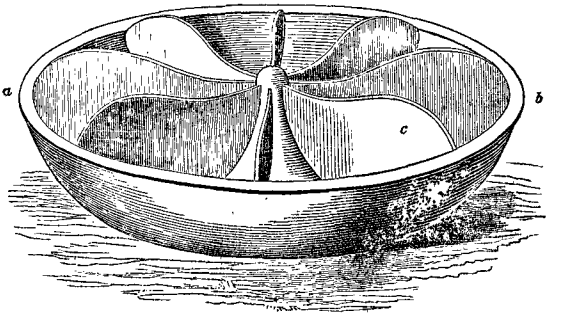
THE PIGS' TROUGH, WITH SUBDIVISIONS, TO STAND IN AN OPENING OF THE OUTER WALL OF THE STYE.

on the hither side being left out of the figure, in order to exhibit the form of the trough. The trough, part of which is seen at *b*, is 4 feet in length, 16 inches wide at top, and 8 inches at bottom, and is 9 inches deep. The two ends *c* and *d* rise in a triangular form to the height of $3\frac{1}{2}$ feet, and are connected at the top by the stretcher-bolt *e*. The lower part of each end extends inward to *f g*, making a breadth of 3 feet 4 inches when complete, but this part of the end *g* in the figure is broken off, to shew part of the trough *b*. Two intermediate

divisions *h h* divide the trough into three compartments; these divisions extend to the same length as the ends *f g*, and are all 21 inches in height. By means of these divisions, each animal, when there are more than one together, has its own stall, and can take its food undisturbed by its neighbours. A swing-door *i* is jointed on the pivots *k k*, to complete the form by filling up the opening of the wall. In the figure this door is thrown to the full extent outward, where it always stands during the time the animals are feeding, and is fixed there by a slide-bolt on the outside. When food is to be introduced the bolt is withdrawn, and the door moved from that position to *l*, and there bolted until the compartments of the trough are cleaned and filled, when the door is again swung back to its original position, and the food is placed before the animals. The door has slits formed in it corresponding to the divisions *h h*, to allow of its swinging freely, and yet have depth sufficient to close the entire opening down to the outward edge of the trough. A dowel or stud *m* is let into the wall at each end, to secure the upper part of the trough. On a late visit to the Duke of Buccleuch's home-farm at Dalkeith Park, which is conducted by Mr Black, I was much interested with the piggery, where the stock is of the finest quality, and, amongst other things of interest, saw what is very probably the original of the trough here described. The troughs in this piggery are composed of wood, but precisely on the same principle as here figured and described, and their introduction there dates as far back as the time of the late Duke Henry of Buccleuch, whose invention they are supposed to be, and which must be at least of forty or more years' standing.

(1669.) *The Ring Pigs'-Trough.*—I have seen in England a very handsome pigs' trough adapted for standing in the middle of a court. It is formed

Fig. 298.



THE RING PIGS'-TROUGH, TO STAND IN A COURT.

also of cast-iron, but is in one entire piece, and is here represented in perspective by fig. 298. Its external appearance, when viewed as it stands on the ground, approaches to that of a hollow hemisphere; but interiorly the bottom parts rise up in the centre, forming a central pillar, thus converting the hemisphere into an annular trough, whose transverse section is a semicircle, and the entire section of the two troughs forms two semicircles conjoined. The diameter *a b* of this trough is 30 inches, the edge is finished with a round baton, serving both for strength and for comfort to the animals who eat out of it; the depth is about 9 inches, and it is divided into eight compartments by the divisions *c*.

which are formed with a convexity on the upper edge to prevent the food being thrown from the one compartment into the other.—J. S.]

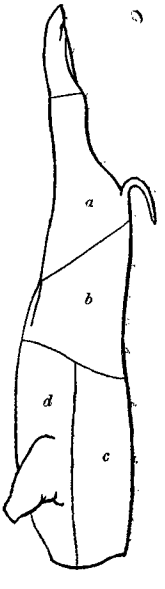
(1670.) As farmers usually dispose of their pig stock on the premises, they have nothing to do in *driving* them, but sometimes they have to take a lot to market for sale, in which case you should be made acquainted with the mode of managing them upon the road. It is a received opinion in the country, that pigs will neither lead nor drive, and the opinion is no doubt founded on correct observation, but still they may be managed by an appeal to the appetite. If the drover walk before his drove, having a small bag of beans under one arm, and drop a bean now and then upon the road, his eager followers will run one before the other, in search of the desired morsel. A steady dog following the drove will prevent any straggling into fields, but a young hasty tyke will annoy the creatures much more than assist the drover. In summer, pigs, when driven, should get leave to drink at any brook or ditch on their way, or pluck grass on the way side. In the market-field, pigs are retained in their stances by dropping beans now and then around a circle circumscribing the drove, when they will place their heads outwards to pick up the beans, and may then be easily kept back by a tap with a switch on the nose. I have seen large lots of pigs managed in this way at the great fairs of Newcastle-upon-Tyne. It is said that the best way of shipping live pigs is to attempt to prevent them running along the gangway, when they evince a determination to run along it, and thus gain the deck.

(1671.) In regard to the *slaughtering* of pigs, they should be made to fast for nearly a day, to clear their bowels of as much food as possible. The season best adapted to the purpose is in the cool months of the year; the flesh in the warm months not becoming sufficiently firm, and is then liable to be fly-blown before it should be cured. For using fresh pork, the season of course does not signify. When you wish to make hams for your own use, Christmas is a good time for slaughtering pigs, and, in doing it, great care should be taken that the animals receive no injury by bruises before being killed, as the flesh, where bruised, will become blood-burned, and will not take with the salt. Butchers are often reckless in slaughtering pigs for this purpose; some stunning them with blows on the head before using the knife, which should never be allowed, as the blows render the head almost useless for curing; others, plunging the knife into the breast and allowing the pigs to run about until they fall down exhausted by loss of blood, a practice which should never be allowed, as it excites the animal unnecessarily, and puts the flesh into an improper state. Butchers are apt to adopt practices, which serve their own purposes, when killing animals, and which may not affect the appearance of meat for the short time they have it in their possession. But these hasty and thoughtless practices will not do with animals that are intended to be cured and kept for a considerable time, for the use of a family. I knew of a pig that was to be slain for ham, being taken by the hind leg by the butcher who was to kill it; and who, in his recklessness, drove its nose against a wall, and the pig was killed on the spot; and, although bled immediately, the flesh never became firm or assumed its proper colour. The shepherd on a farm acts the part of butcher to the pigs, and will manage such a matter as this better than a butcher. When the time for slaughtering arrives, the animals should be taken out of their sties gently one by one as slaughtered, and placed on their back on a considerable quantity of straw, and held in that position by assistants, while a long knife is introduced with a firm hand through the counter near the bottom of the neck, through the opening between the ribs at the sternum into the

heart, care being taken that the point of the knife does not miss the opening, and go between the shoulder-blade and the ribs. This error is frequently committed in slaughtering pigs; it is called *shouldering*, and has the effect of collecting a mass of blood under the shoulder-blade, where it coagulates, and prevents the whole shoulder from being cured. Before the slaughtering commences, a large quantity of boiling water should be provided, with which to scald off the hair. This is effected either by putting the carcass into a large tub of water, or, should there not be a tub of sufficient size, the hot water can be poured on the carcass on the straw, and scraped clean of the hair from every part of the body. The hoofs are taken off at this time. Another plan is to singe the bristles off by fire in a state of flame; and this practice is much in use in some parts of England, but not at all in Scotland. I confess I can see no advantage derived from singeing which scalding cannot afford; it renders the skin dirty by the smoke necessarily arising from the flame and combustion of the bristles. The net fat and entrails are separated, and the carcass is dressed in the most simple manner, without flourishes, and with only a single stretcher to keep apart the flaps of the belly.

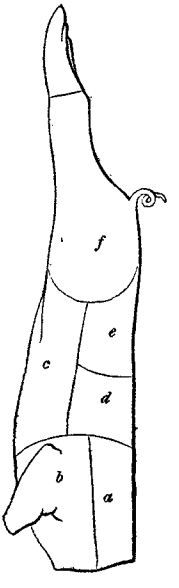
(1672.) The carcass hangs in the slaughter-house until next day, when it is sawn up the back-bone into two sides. If it is intended for pickled pork, the sides are cut up in Scotland in the same way as the Scotch mode of cutting up mutton (fig. 255), namely, *a*, fig. 299, is the leg, and *b* the loin, in the hind-quarter; *c* the ribs, and *d* the breast, in the fore-quarter. The leg *a* makes an excellent leg of pickled pork, served with pea-pudding; and the loin *b* a juicy

Fig. 299.



THE SCOTCH MODE OF CUTTING UP A CARCASS OF PORK.

Fig. 300.



THE ENGLISH MODE OF CUTTING UP A CARCASS OF PORK.

fresh roast. The back-ribs of *c* are a fine roasting piece, and also for pork chops, one of the most delicate dishes of the hasty modes of dressing meat. The

fore-end of *c*, and the whole of the breast *d*, are fit for pickling. The head, split in two, is also pickled, and considered a delicacy, as the fat upon the cheeks is gristly.

(1673.) The English mode of cutting up pork is different from what has just been described, and, upon the whole, perhaps better adapted for family use. Fig. 300 gives a representation of it, where, in the fore-quarter, *a* is the spare rib, so called because the flesh and fat are taken off the ribs for salting; and the ribs are then roasted, and make a savoury dish: *b* is the hand or shoulder, fit for pickling; *c* the belly or spring, also fit for pickling, or for rolling up, when well seasoned and stuffed, for brawn, and eaten as a relish. In the hind-quarter are *d* the fore and *e* the hind loin, both best when roasted, the fore one *d* also making excellent chops; and *f* the leg, which is cut short for pickling. The *neck* is called a *crop* of pork, and, when divided into its vertebræ, are cut for chops, and called *griskins*. The head, when divided in two, is again divided at the jaw into an upper part called the *face* or *cheek*, and the lower part named the *chap*. Sometimes the two chaps are not divided.

(1674.) Of judging of pork, "the meat of pigs cut or spayed when young, is the best. That of a boar, though young, or of a hog of full growth, the flesh will be hard, tough, reddish, and of a rank smell; the fat skinny and hard; the skin very thick and tough, and, being pinched up, it will immediately fall again. If it be young, in pinching the lean between the fingers, it will break; and, if you nip the skin with your nails, it will be dented. But if the fat be soft and pulpy, like lard, if the lean be tough, and the fat flabby and spongy, and the skin be so hard that you cannot nip it with your nails, it is old. If there are little kernels in the fat, like hail shot, the pork is measly and unwholesome, and butchers are punishable for selling it. The freshness of pork may be known by putting the finger under the bone, and smelling it. The flesh of stale pork, also, is sweaty and clammy; that of fresh killed cool and smooth. Pork fed at distilleries is not good for curing, the fat being spongy. Dairy-fed pork is the best."* A good way of ascertaining the quality of a carcass of pork, is to insert a pen-knife through the skin and flesh the whole length of the blade, and if the resistance to it is firm and uniform, the flesh is good; and if irregular, and loose, and pulpy, the pork has not been well fed. The smell retained by the knife will shew whether the flesh is wholesome or tainted.

(1675.) According to Mr Donovan, a hand of salt pork, weighing 4 lb. 5 oz., lost in boiling 11 oz. The bone weighed 9 oz.; the meat was 3 lb. 1 oz. If the first cost of the pork was 7½d. per lb., the meat alone, when duly boiled, cost 10¼d., and with the bone nearly 9d. per lb. The loss in boiling salt pork is consequently 15½ per cent.†

(1676.) Of the time required for digesting pork dressed in various ways, pigs' feet soused and boiled take 1 hour; sucking pig roasted, 2½ hours; pork recently salted, raw or stewed, 3 hours; pork-steak, and recently salted pork, broiled, 3¼ hours; pork recently salted, fried, 4½ hours; pork recently salted, boiled, 4½ hours; and pork, fat and lean, roasted, 5¼ hours.‡

(1677.) *Pickled* pork derives its name from the mode in which pork is cured in a strong brine or pickle of salt and water. The flesh is first rubbed with salt, then subjected to pressure, then rubbed again, and packed in barrels, and strong

* The Experienced Butcher, p. 155.

† Donovan's Domestic Economy, vol. ii.

‡ Combe on Digestion and Dietetics, p. 134.

brine poured over it. Immense quantities of pork are pickled, for home and foreign consumption, by the pieces being simply placed in brine, but is, of course, inferior to what is cured as above described. The largest establishments for the curing of pork I ever saw was in Belfast. A carcass is cut up in a few seconds in this manner: One man stands at the end of a large hacking block of wood, provided with a long-faced hatchet, and two others stand on each side of the block. A carcass, of whatever size, is placed on the block, on its back, with its head towards the hatchet; a man then seizes each of the limbs, and keeps the carcass open. With three or four strokes of the hatchet, the carcass is divided into two from snout to tail. One chop cuts off each of the half heads, and one each of the legs. The heads are thrown into one heap, and the legs into another. The two men at the hind-quarter then take their knives and cut off the hams, which are put by themselves, and taken away and rubbed with salt, and placed in rows on the ground, with the fleshy side uppermost, covered with dry salt. The remainder of the carcass gets two or three chops across the ribs, according to its size, and the pieces are thrown into a large tub of brine. The whole thing is done in far less time than I have taken to describe it. For family use, no pickle should be used in curing pork, as it extracts the natural juices of the meat; the pieces, cut of a convenient size, should be rubbed with good dry Liverpool salt, both on the skinny and fleshy parts, and packed in a jar covered with a lid or cloth; and from *eight* days to a fortnight, according to the size and thickness of the pieces, the pork will be ready for use. The navy tierce of pork consists each of 80 pieces of 4 lb.

(1678.) When the carcasses are meant for *ham* for family use, they are treated in this manner: After being sawn asunder, the sides should be carefully handled, that the back-bone be not broken, and placed on a table, when all the loose seam or tallow is taken out, and the kidneys extracted out of it. The muscle lying along the back-bone under the loin is taken out, and, when used fresh, makes an excellent collop for sausages; and the diaphragm or skirt is also cut off. The tongue is cut out, the brains scooped out, the ears extracted by their sockets, the tail cut away, and the four feet disjointed at the knees. Every loose and useless shred of fat, sinew, nerve, flesh, and skin, should be carefully removed.

(1679.) The next process is the *salting*. Let the sides be placed with the skin side uppermost, and all where there is *skin* let it be rubbed hard with the palm of the hands, by two persons, for fully half an hour, in a warm place, with good dry salt, taken in indefinite quantity. Thin-skinned uniformly fat pork will feel warm under the rubbing, and the skin become somewhat loose and sweaty, which are the best signs that the flesh is taking in the salt. A hard-skinned side will not exhibit these symptoms, nevertheless it will take in the salt too, though not so kindly. The ends of the shanks should be well rubbed with salt. After this rubbing, the side is turned over, and 4 oz. of saltpetre, finely pounded, are strewed over the inside, and especially over all the fleshy parts that have been cut with the knife, such as along the line of the back-bone, and the inside of the ham. The use of the saltpetre is to give an uniformity to, and heighten the colour of, the flesh, which, in pork, becomes red on being converted into ham. A layer of salt of about $\frac{1}{2}$ of an inch thick is then laid on the side over the saltpetre. In this state the side is carried carefully, and laid upon a board or wooden floor. Other sides are treated exactly in the same manner, one after the other, and laid upon one another, with the skinny sides

downmost; but perhaps 4 sides are enough to form one heap, laid alternately head and tail, to lie compactly. A board is then laid above them, supporting a number of weights; the whole being covered with a woollen cloth, to keep out the frost, should it arrive. In the course of a day or two, brine will run from the heaps, which should be wiped up from the floor. In a fortnight the sides should again be laid on the table, and the brine that may have collected on the ribs poured out, the loose wet salt removed, and the skinny side again rubbed with dry salt for about a quarter of an hour. The loose salt should then be all brushed off by the hand, and the skin wiped dry. To prevent flies blowing the end of the shanks at the joints, a brown-paper bag makes a close enough covering for them; and a wooden skewer being thrust through both shank and bag, and both tied firmly to the leg with twine, the remainder of the twine is formed into a stout loop by which the side is suspended from hooks. The inside is then covered with an uniform coating of barley or pease-meal, pushing it well into every crevice with the finger. The dampness of the flesh will make the meal stick on, but there is none put on the skinny side. The side is then hung up from the roof of a warm dry room, the kitchen being the most appropriate place; and the kitchen roof thus garnished conveys an idea of plenty and good cheer. I sent this recipe, through a friend, to a lady whom I understood was at the time engaged on a work on the culinary art, and it may be found substantially in the above shape in her valuable pages.*

(1680.) After the sides have hung up in this state for about a month, the heads should be cut off one after the other, and eaten as green pig's-cheek; and few dishes are relished with more gusto, either by itself, or with fowl. The bacon hangs there until it is quite dry and hard to the feel, which will be about May-day, when it may be removed to a less warm but still *dry* apartment; and though it drop a little grease from the heat, better it do that than become again damp after only a partial winning, when the meat loses much of its flavour, and becomes clammy, after which it will not easily dry again into a firm state, and will, moreover, be more liable to be attacked by fly in the ensuing summer. The incision made in the flesh on the removal of the heads and other parts, will be enough protected if covered with thin paper dipped in oil, which prevents both mouldiness and waste of the cut surface. The bacon should not be used until that is prepared for the succeeding year, one curing just serving the year; and the advantage of this mode of curing is, that it enables you to cut out any size of piece and whatever piece you please. A not uncommon practice is to cut out the hams at once, and cure them by themselves, and then take out the ribs, which are roasted as spare-ribs, and the flesh and fat are cured as a *gammon* or *flitch*,—an old English favourite.† Ancient custom makes many reconciled to this practice, and in the case of people preparing bacon for sale, it may be profitably followed; but for family use, when the customs of markets are not studied, hams are surely better uncut until used, and, when used, cut of the size required, and the flitch will certainly keep safer with the ribs attached to them than left bare.

* Dalgairns' Practice of Cookery, p. 518, edition of 1829.

† The ancient custom of delivering a flitch of bacon to any couple who had been married a year and a day, on taking a prescribed oath, in verse, implying that no wrangling had existed between them, is said, in the Beauties of England and Wales, vol. v. p. 407, to have been imposed on the manor of Little Dunmow, in Essex, by some benefactor; that the earliest delivery of the bacon on record occurred in the 23d year of Henry VI., and that the last claimants received the gift on the 20th June 1751. A similar custom in the manor of Whichenovre, in Staffordshire, is described in Nos. 607 and 608 of the Spectator.

(1681.) When it is desired to smoke ham, the proper time is after the side has been covered with the pea or barley meal. The smoke of birch wood, when burning slowly, is what is best for the purpose; but that from the sawdust of any hardwood answers very well. The bacon requires to be kept in the smoke for three or four days, and should not be placed so near the fire as to melt the fat. The process of smoking, however, is troublesome to the farmer who has not premises suitable for conducting it; and there are now few old-fashioned *lums* in the country. The same end will be served by steeping the bacon a few hours in wood-vinegar, the pyroligneous acid.

(1682.) From experiment, it was ascertained by Mr Donovan, that if the first cost of ham be 10d. per lb., the meat, duly boiled, skinned, and browned, will cost 1s. $1\frac{1}{3}$d. per lb.; the loss thereby being consequently 33 per cent.

(1683.) Hog's lard is rendered in exactly the same manner as mutton suet (1413.); but as lard is liable to become rancid, yellow-coloured, and acquire a strong smell when exposed to the air, it is usually tied up in bladders. For this purpose, it is allowed to cool a while, after it is melted, and the bladder (a pig's or calf's) being made ready by being thoroughly cleaned and turned outside in, is filled with the lard by a funnel, and tied up. Lard "melts completely at 99° Fahr., and then has the appearance of a transparent and nearly colourless fixed oil. A thermometer placed in it sinks gradually to 80°. The lard then begins to congeal, and the thermometer remains at 80° all the time of congealing, which occupies several minutes. It is clear from this, that 80° is the melting point of hog's lard. Its specific gravity at 102° is 0.9028; at 60°, it is 0.9302. . . . . It consists of elain 62 parts and of stearin 38 parts out of the 100 parts. . . . . When subjected to pressure between folds of blotting paper, the elain is absorbed, while the stearin remains."* For domestic purposes, hog's lard is better than even butter for frying fish; but is quite unfit for pastry, though much used in that way on the score of economy.

(1684.) Hog's skin is usually thick, and, when tanned, its great toughness renders it valuable for the seats of riding saddles. Hog's bristles are formed into brushes for painters and artists, and for numerous domestic uses. Some of the offals of the pig make excellent domestic dishes, such as blood, mealy, and sweet puddings; and pork sausages, made of the tender muscle under the lumbar vertebræ, are sweeter, higher flavoured, and more delicious than those of beef. If it were not for taking up too much room, I could give excellent recipes for making these puddings and sausages; because I do not think such matter foreign to the pages of a work which professes to make you acquainted with what can be made available on a farm.

(1685.) An experiment on the comparative advantages of feeding pigs on raw and boiled food was made in 1833 by Mr John Dudgeon, Spylaw, Roxburghshire. He put up 6 *he* pigs in one lot, and 5 *she* ones in another, and they were all carefully *cut*, and 9 weeks old. The he pigs were put on *boiled* food, namely, potatoes and hashed beans; the she ones on raw of the same sort. The 6 he pigs increased in live-weight, from 2d July to 12th October, 38 stones 6 lb. 4 oz., or 6 st. 5 lb. 11 oz. each; whereas the 5 she ones only increased, in the same time, 17 st. 11 lb. 8 oz., or 3 st. 7 lb. 14 oz. each. Other 3 pigs were fed at the same time on boiled and raw food indiscriminately, as it happened to be left over after serving the other two lots. The facts brought out in this ex-

* Thomson's Animal Chemistry, p. 134.

periment are, that the pigs "fed exclusively upon boiled meat did thrive in a superior manner to the others, and even to those which had an occasional mixture of raw and boiled meat; thus shewing that boiled meat is at all times more nutritive than raw." The "pigs were repeatedly washed with soap and water, which refreshed them greatly, and caused them to relish their food." Those "which got a mixture of food both prepared and raw, approached nearer to those which were fed on boiled to their feeding properties; but they appeared occasionally shy at having their meat so mixed. It is therefore better, in general, to continue for some time only one description of food; as, whatever the animals become accustomed to, they begin to relish, and thrive upon it accordingly." *

(1686.) Mr Robert Walker, Ferrygate, East Lothian, also made an experiment on the same subject in the same year. He put 5 pigs on steamed potatoes and prepared broken barley, and other 5 on raw potatoes and raw broken barley. The pigs were 2½ months old. On the 4th March 1833, the live-weight of the 5 pigs fed on raw food was 7 st. 10 lb.; on the 1st June following, it was 16 st. 13 lb., shewing an increase of 8 st. 3 lb., or an increase in each pig of 1 st. 9 lb. On the 4th March, the live-weight of those fed on steamed food was 7 st. 8 lb., and on the 1st June it was 19 st. 13 lb., shewing an increase over the whole of 12 st. 5 lb., or an increase on each pig of 2 st. 6½ lb. The increase in the time was 67 lb. more than double the original live-weight of the pigs fed on steamed food; whereas, in those fed on raw, the increase was only 7 lb. more than the double; "so that there can be very little doubt," as Mr Walker concludes, "that steamed food is more profitable for feeding pigs than raw food. In fact, I do not think it possible to make pigs *fat* on raw potatoes, without other food, when confined to them alone." †

(1687.) There is an acquaintance of mine, who, on converting potatoes into tapioca, a process which I shall notice in autumn, when speaking of the potato, which he raises in great quantities on a farm of large extent, uses part of the refuse for his horses, and part, assisted by pease, for feeding pigs, which latter he does to the extent, I understand, of nearly 400 head every year.

(1688.) Dairy farms are well suited for rearing pigs on the dairy refuse in summer, but in winter the most that can be done is to keep the brood sows in pig in fair condition for littering in spring. On carse and pastoral farms, no more pigs can conveniently be reared than to serve the farmer's family. On mixed farms, pigs constitute a portion of the regular stock.

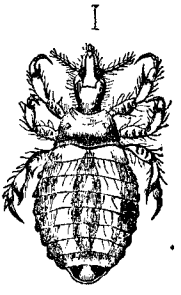
(1689.) With regard to the *diseases* of swine, they are fortunately not numerous, as it is no easy matter to administer medicine to them. The safest plan, in most cases, I believe, is to slaughter them whenever any symptoms of internal disease shew themselves. Swine are infested with a louse (*Hæmatopinus suis*), like all domesticated animals. It is represented in fig. 301. Head and thorax of a dull rusty colour, the former pear-shaped and narrow, with an angular black line at the apex, and one on each side before the eyes; abdomen large, flat, and oval, of a bluish or yellowish ash-grey colour, most of the segments with a black horny prominence at each side, surrounding a white breathing-hole; legs pale ochre-yellow, the thigh marked with dusky bands; length 1¼ to 1¾ line. This species is generally very plentiful on swine, more particularly on those fresh imported from Ireland. It appears to abound most on lean ani-

* Prize Essays of the Highland and Agricultural Society, vol. x. p. 275-9.

† Ibid. vol. x. p. 279-80.

mals. "In walking," says Mr Denny, "it uses the claw and tibial tooth with great facility (which act as a finger and thumb), in taking hold of a single hair; the male is much smaller, sub-orbicular, and the segments lobate. The egg or nit is $\frac{2}{4}$ of a line in length, of a cream colour, and elegantly shagreened, oblong, and slightly acuminated, surrounded by a lid which, when the young insect is ready to emerge, splits circularly—or, as a botanist would say, has a circumcisile dehiscence."* Oil in the first stage, and mercurial ointment in after stages, will destroy this insect.†

Fig. 301.



THE SOW-LOUSE (HÆMATOPINUS SUIS).

(1690.) *Consumption* is a disease which affects pigs. It is brought on by "neglect and exposure to cold and damp. The animal becomes thin, the coat staring, the skin appearing as if glued to the ribs; obstinate cough supervenes; discharge is frequent from the nose, and glandular swellings appear about the neck. On dissection, the lungs are studded with tubercles." "It is in the early stage alone of the complaint," says Professor Dick, "that any thing can be done, and the prospect of cure is but faint."‡ In alluding to the lungs, I may mention a remarkable instance of their state I once observed in a sow of my own. She had borne several litters, and became asthmatic, which increasing so as to appear distressing to the animal, she was killed; and one lobe of the lungs was found to be so completely ossified, that its surface was converted into a shell nearly as hard as the crust of a crab, and it was filled with a thick yellow fluid. Having understood afterwards that this was a remarkable case, I regret that the lobe was not examined by a veterinarian. I take this opportunity of suggesting to every farmer, who may happen to meet with any instance of structural disorganization in any part of any animal he owns, to have it examined by a competent veterinarian.

(1691.) Pigs are subject to a cutaneous disease called *measles*, which is supposed to render the flesh unwholesome. "The measles," says a writer, "are very prevalent, though seldom fatal; and if not checked, affect the grain of the meat, which may be commonly seen in the shops of a faded colour, and the flesh punctured, as it were, with small holes, or distensions of the fibre. The commencement of the disease appears in languor and decline of appetite, followed by small pustules in the throat, together with red and purple eruptions, more distinct after death than during the life of the animal; but may, it is said, be removed in this stage by giving small quantities of levigated crude antimony in the food. Generally speaking, even if the animals be in health, a small quantity of nitre and sulphur, occasionally mixed up with their food, besides stimulating their appetite, will frequently prevent disease; neither can we too much insist on cleanliness, nor upon the punctual regularity of feeding at stated times."§ The injunction contained in the last words, if followed, will do more for the preservation of health in pigs, than the administration of any specific after disease has once shewn itself. I can safely say, that, with the simple means here enjoined, I never had a pig that was in the least affected in the skin by either disease or vermin.

* Denny's Monographia Anoplurorum Britanniæ.

† I find that the ox-louse (*Hæmatopinus eurysternus*), fig, 268, has been erroneously printed on page 151.

‡ Dick's Manual of Veterinary Science, p. 84.

§ British Husbandry, vol. ii. p. 530.

38. OF THE TREATMENT OF FOWLS IN WINTER.

" Thither the household feathery tribe crowd,
The crested cock, with all his female train,
Pensive and dripping;———"

THOMSON.

(1692.) Of all the animals reared on a farm, there are none so much neglected by the farmer, both in regard to the selection of their kind, and their qualifications to fatten, as all the sorts of domesticated fowls found in the farm-yard. Indeed, the very supposition that *he* would devote any of *his* time to the consideration of poultry, is regarded as a positive affront on his manhood. Women, in his estimation, may be fit enough for such a charge, and doubtless they would do it well, provided they were not begrudged every particle of food bestowed upon those useful creatures. The consequence is what might be expected in the circumstances, that go to most farm-steads and the surprise will be to meet a single fowl of any description in *good* condition, that is to say, in such condition that it may be killed at the instant in a fit state for the table, which it might be if it had been treated as a fattening animal from its birth. The usual objection urged against feeding fowls is, that it does not pay, and no doubt the usual price received for lean, stringy-fleshed, sinewy-legged fowls is far from remunerative; but whose fault is it but the rearer of them, that fowls are sent to market in such a state, and why should purchasers give a high price for any animal, be it fowl or beast, that is in under condition? There would be some excuse for the existence of lean fowls at a farm-stead were there any difficulty of fattening poultry of every kind at no great expense; but the idea of expense is a perfect bugbear; and this one, like all others that seize us through our fears, would vanish were a plan adopted for rearing fowls more consonant to common sense than the one usually pursued. To judge from common practice, the prevalent sentiment seems to be, that fowls cannot be ill off when they get leave to shift for themselves. Such a principle is a grievous error in the rearing of any kind of live stock. Better a man keep no stock at all than allow such a sentiment to influence his conduct to them. Fowls may be considered worthless stock, and so they generally *are*, but are you sure that it is not your mode of managing them that renders them so? But apart from every consideration of profit to be derived from sales in market-towns, there is the superior one of the farmer having it *at all times* in his power to eat a well-fed fowl at his own table; and there is no good reason why

he should not be able to enjoy such a luxury at any time he chooses. There would be economy in it too, in the long run, inasmuch as *good* poultry, at command, will keep him out of the butcher market, into which he cannot go without cash in hand, and *cash* he cannot command except by realising the money value of some commodity or other from the farm. Few farmers kill their own mutton, that is to say, keep fine fat sheep for their own use; lamb, they may kill in the season; but as to beef, it must be purchased; so that, situate as the farmer usually is, the produce of the poultry-yard and pig-sty constitute the principal items of his board. And why should he not have these in the highest perfection?

(1693.) Winter is a season in which no fowls are brought forth in Great Britain. The climate is too severe for them; the cold would either kill chickens outright, or prevent their growth so as to render it unprofitable to bestow the great attention which their rearing would require. None of the fowls usually lay eggs in winter. But notwithstanding this natural barrier to the propagation of fowls in winter, both chickens and eggs may, by good management, be obtained in that season.

(1694.) The ordinary fowls on a farm are the cock (*Phasianus gallus*), the turkey (*Meleagris gallopavo*), the goose (*Anas anser*), the duck (*Anas domestica*), and the pigeon (*Columba livia*), the white backed or rock dove, which was long confounded with the blue backed dove (*Columba œnas*). In regard to all these, I shall first state the condition in which they are found on a farm in winter, and then describe the mode in which food should be daily supplied them; and as they may all be fed with nearly the same ingredients, the mode of feeding to be described will apply to all.

(1695.) And first, in regard to the condition of the *hen*. As hatchings of chickens are brought out from April to September, there will be broods of chickens of different ages in winter; some as old as to be capable of laying their first eggs, and others only mere chickens. The portion of those broods which should be taken for domestic use are the young cocks and the older hens, there being a feeling of reluctance to kill young hens, which will supply eggs largely in the following season. At all events, should any hen-chickens be used for the table, the most likely to become good layers next season should be preserved. The marks of a chicken likely to become a good hen are a small head, bright eyes, tapering neck, full breast, straight back, plump ovoidal-shaped body, and moderate-lengthed grey-coloured legs. All the yellow-legged chickens should be used, whether male or female, as their flesh never has so fine an appearance as the others. As to the colour of the feathers, that is not a matter of much importance, some preferring to have them all

white, others all black; but I believe there is none better for every useful purpose than the mottled grey. Young fowls may either be roasted or boiled, the male making the best roast, and the female the neatest boil. The older birds may be boiled by themselves, and eaten with bacon, or assist in making broth, or that once favourite winter-soup in Scotland—*cockieleekie*. A chicken never eats more tenderly than when killed a short time before being dressed; but if not so soon used, it should hang in the larder for 3 or 4 days in winter. An old fowl will become the more tender, on being kept for a week before being used. The criterion of a *fat* hen is a plump breast, and the rump feeling thick, fat, firm, on being handled laterally between the finger and thumb. A corroborative criterion is thickness and fatness of the skin of the abdomen, and the existence of fat under the wings. White flesh is always preferable, though poulterers insist that a yellow-*skinned* chicken makes the most delicate *roast*. A hen is deprived of life by dislocation of the neck by drawing, where the blood collects and coagulates.

(1696.) *Turkies* being hatched in May, will be full grown in stature by winter, and, if they have been well fed in the interval, will be ready for use. Indeed, the Christmas season never fails to create a large demand for turkies, and it must be owned there are few more delicate and beautiful dishes presented at table, or a more acceptable present given to a friend, than a fine turkey. Young cocks are selected for roasting, and young hens for boiling, and both are most relished with a slice of ham, or of pickled ox-tongue. The varieties in common use are white, black, and mottled grey; and of these the white yields the fairest and most tender flesh. The criterion of a good turkey is fulness of the muscles covering the breast-bone, thickness of the rump, and existence of fat under the wings; but the turkey does not yield much fat, its greatest property being plenty of white flesh. Young turkies attain to great weights. I have had yearly young cocks weighing, at Christmas, 18 lb. each in their feathers. Norfolk has long been noted for its turkies, where they are fed on buck-wheat, and large droves are annually sent to the London market. A turkey is deprived of life by cutting its throat, when it becomes completely bled. The barbarous practice of cutting out their tongues, and hanging them up by the feet to bleed slowly to death, for the alleged purpose of securing whiteness of flesh, ought to be severely reprobated.

(1697.) *Geese*, having been hatched in the early part of summer, will also be full grown and fit for use in winter. I believe there is very little difference in flavour or appearance, as a dish, between the young male and young female goose, though there may be some difference of size. The criterion of a fat goose is plumpness of muscle over the breast, and thickness of rump when alive; and, when dead and plucked,

the additional one of a uniform covering of *white* fat over the whole breast. It is a very good young goose that weighs in its feathers 12 lb. at Christmas. The goose is as favourite a dish at Christmas as the turkey; but people tire of it sooner, and in consequence it is not so frequently served at table. A green goose at Michaelmas is, however, considered a greater delicacy in England than a turkey-poult. Geese are always roasted; and their flesh is much heightened in flavour by a seasoning of onions as a stuffing, and by being served up with apple-sauce. A goose should be kept a few days before being used. It is bled to death by an incision across the back of the head, which completely bleeds it. Large flocks of geese are reared in Lincolnshire, and from thence driven to the London market. It is rare to see a *grey* gander, and as rare to meet a *white* goose. I remember seeing large flocks of geese on the islands in the Elbe near Hamburgh, which were reared chiefly for their quills, their carcasses being salted and sent to Holland. The invention of the steel-pen, however, has much injured the quill-dressing trade, and, in consequence, *good* quills are now not easily obtained; and their deterioration still farther encourages the use of the steel-pen. Geese have long been proverbially good watchers. I have seen a gander announce the approach of beggars towards the kitchen door as lustily as any watch-dog.

(1698.) *Ducks*, being also early hatched, are in fine condition in winter, if they have been properly fed. Ducklings soon become fit for use, and are much relished with green peas in summer. I believe there is no difference in flavour and delicacy betwixt a young male and young female duck. They are most frequently roasted, and stuffed with sage and onions; though often stewed, and if smothered among onions, when stewed, there are few more savoury dishes that can be presented at a farmer's table. A duck never eats better than when killed immediately before being dressed. It is deprived of life by chopping off the head with a cleaver, which completely bleeds it.

(1699.) Hens and turkies are most easily caught on their roosts at night with a light, which seems to stupify them; and geese and ducks may be caught in any outhouse at any time they are driven into it.

(1700.) As young pigeons alone are made use of, and as the pigeon does not hatch in winter, they require no other notice at present than what regards their feeding; and to give you an idea of their gastronomic powers, of three rock-doves which were sent to Professor MacGillivray, "The number of oat-seeds in the crop of the second amounted to 1000 and odds, and the barley-seeds in that of another were 510. Now, supposing," says he, "there may be 5000 wild pigeons in Shetland, or in Fetlar, which fed on grain for 6 months every year, and fill

their crops once a-day, half of them with barley and half with oats, the number of seeds picked up by them would be 229,500,000 grains of barley, and 450,000,000 grains of oats,—a quantity which would gladden many poor families in a season of scarcity. I am unable," he adds, "to estimate the number of bushels, and must leave the task to the curious."* And the task I have undertaken, and find the result to be 422 bushels of barley, and 786 of oats.†

(1701.) The prices of poultry, in towns, are pretty high. In Edinburgh, for instance, in winter, a couple of chickens are 2s. 6d.; hens from 1s. to 1s. 9d. each; ducks 3s. per couple; turkies 3s. 6d. to 8s. a-piece; geese 3s. 6d. to 5s. each; and eggs are from 1s. 2d. to 1s. 8d. per dozen. In the country towns the prices are fully one-third below these; but the highest prices in London are not more. In Russia, fat turkies are 1s. 10d., geese 2s., and fowls and ducks 1s. 3d. *per couple!* ‡ In Ireland, poultry of all kinds are cheap; but not so much so as in Russia.

(1702.) Farmers usually sell poultry alive, excepting in some parts of the country, such as the Borders, where geese are killed and plucked, for the sake of their feathers, before being sent to market. Poulterers in towns, on the other hand, kill and pluck every sort of fowl for sale, so that the purchaser has it in his power to judge of the carcass; and if he buys an inferior article at a high price, it must be his own fault. It is easy to judge of a plucked fowl, whether old or young, by the state of the *legs*. If a hen's spur is hard, and the scales on the legs rough, she is old, whether you see her head or no; but the head will corroborate your observation, if the under-bill is so stiff that you cannot bend it down, and the comb thick and rough. A young hen has only the rudiments of spurs, the scales on the legs smooth, glossy, and fresh-coloured, whatever the colour may be, the claws tender and short, the under bill soft, and the comb thin, and smooth. An old hen-turkey has rough scales on the legs, callosities on the soles of the feet, and long strong claws; a young one the reverse of all these marks. When the feathers are on, an old turkey-cock has a long beard, a young cock but a sprouting one; and when they are off, the smooth scales on the legs decide the point, beside difference of size in the wattles of the neck, and in the elastic snot upon the nose. An old goose, when alive, is known by the roughness of

* MacGillivray's History of British Birds, vol. i. p. 285.

† I ascertained the result by weight; and as the facts may be worth recording, I may mention that, in an average of 3 drachms, there were 75 grains of chevalier barley in each drachm of a sample weighing 56½ lb. per bushel; and 97 grains of Siberian early oat in 1 drachm of a sample weighing 46 lb. per bushel. Of Chidham white wheat, weighing 65 lb. per bushel, there were 86 grains in the drachm.

‡ Venables' Tour in Russia, appendix.

the legs, the strength of the wings, particularly at the pinions, the thickness and strength of the bill, and the firmness and thickness of the feathers; and when plucked, by the legs, pinions, and bill, and the coarseness of the skin. Ducks are distinguished by the same means, but there is this difference, that a duckling's bill is much longer in proportion to the breadth of its head than that of an old duck. A young pigeon is easily recognised by its pale-coloured, smooth-scaled, tender, collapsed feet, and the yellow long down interspersed among the feathers. A pigeon that can fly has always red-coloured legs, and no down, and is then too old for use.

(1703.) The hen-houses are placed at *d* on the plan and view, figs. 3 and 4, Plates III. and IV. They are divided into 3 apartments, each having a giblet-check door to open outwards, and all included within a court-yard, provided with an outer door and lock. The use of 3 apartments is, to devote one of them to the hens and turkies, which roost high; another to the geese and ducks, which rest on the floor; and the third to a hatching-house to accommodate both. When geese are obliged to rest below hens, they are made uncomfortable and dirty by the droppings of those which roost above them. The innermost apartment being the largest, should be occupied by the most numerous body of fowls, namely, the hens and turkies; the right-hand one by the geese and ducks; and the left-hand one in hatching, to which access is given by a trap-ladder and opening through the wall at the road, to admit the laying hens. There should be an opening with a sliding-shut in the outer door, as well as one in the doors of the geese-house and hatching-house, to give admittance to the birds when disposed to go to rest in the afternoon; and these shuts should be fastened every night. In the accommodation thus appropriated to every class of fowls, each apartment will be taken up by its own class. The usual practice is to put all kinds of fowls into the same apartment; and the small space occupied by even this single room seems to be grudged, as if any sort of accommodation, however hampered or incommodious, were good enough for poultry. How breeders and feeders of stock can reconcile their minds to such indifference towards any class of their live-stock, while possessing the desire of having a good fowl at their table, is more than I can imagine, unless they believe that quite opposite modes of treatment will produce similar results! In very cold weather the inner apartment, occupied by the hens and turkies, could be kept sufficiently warm, by heaping the horse-dung from the work-stable under and upon the feeding-trough in the court K, immediately behind the back wall of the hen-house, as high up against it as is thought desirable; and a quantity

of straw could be put on the slated roofs of all the apartments during a continued storm. Snow forms a warm covering on a roof, but the heat from fowls roosting under soon melts it; so that it is better to remove the snow and put on straw, and allow the snow to fall upon the straw. Fowls thrive best where there is a mild temperature, but not a great heat; and such expedients will supply them with a sufficiency of heat during the severity of a winter storm.

(1704.) The pigeon-house is placed in the gable of the boiling-house U, fig. 3, Plate III., to receive warmth in winter from the fire usually kept in that apartment. When pigeons are thus artificially supplied with heat, they not only continue to hatch longer in autumn, but will recommence in spring sooner than they would otherwise do. Indeed, by a little management in this way, and taking care to keep the house always pretty full of pigeons to retain heat amongst themselves, they might be encouraged to hatch all the year, with the exception, perhaps, of two months in the depth of winter, in December and January. Pigeons, like other birds, are most prolific when not too old; and as old cocks are exceedingly tyrannical to the young ones, they should be destroyed as well as the oldest hens. It is no easy matter to get hold of flying pigeons to kill them, as they are always on the alert and make their escape; but there are various ways of destroying them, and a favourite one is shooting, but it is not the best in this case, as young ones may be wounded while aiming at the older birds. The safest plan is to mark the birds you wish to destroy daily for some time, in order to recognise them readily, and the old cocks are easily discernible by their forward manner, and the interruption they give at the pigeon-holes to the entrance of others. These remarks apply specially to the recognition of old cocks, but are inapplicable to old hens, as they never conduct themselves so. Other means must, therefore, be taken to recognise them, and the same may be applied to the cocks; and these are those given above for the detection of dead old and young pigeons. The marks are rough scaly legs, callous soles of the feet, high red colour of the scales, strong bill, strong wings, thick covering of feathers, and brightness of the play of colours upon the neck. All these marks are most conspicuous in winter, the very season when the process of *cocking* a pigeon-house, as it is termed, should be performed, as then there are no young to be unknowingly deprived of their parents. The safest way of doing it is to enter the pigeon-house gently, late of a dark night, with a light. On entering with the light, and shutting the door, it will bewilder the pigeons, and the first movement should be to stop up the holes to prevent them escaping, which the old cocks will be the first to attempt;

and should the holes be beyond the reach of the floor, a ladder should be taken in to assist in effecting the purpose. Two persons are required to capture the pigeons, as they will endeavour to elude every attempt; and one to take special charge of the light, which, if taken out of the lantern—and it should be so if the lantern is not of glass—to afford plenty of light, is apt to be blown out by the wind occasioned by the pigeons flying about. Should this be the case, a lucifer match should be in readiness to rekindle it. A light landing net used by anglers is a convenient instrument for entrapping a pigeon, whether sitting or flying. Every bird that is caught should be examined and recognised, and every one exhibiting signs of old age should be destroyed, by pushing the point of the thumb with force into the back of the head, and severing the cervical vertebræ, or applying the teeth for that purpose; but should these modes be disliked or impracticable, rather than torture the poor devoted animals by abortive attempts, let their heads be cut off at once by a sharp table-knife. When this process of *weeding* is performing, it should be done effectually at once, and not repeated in the same season, as a nocturnal visitation such as this cannot fail to intimidate the whole flock. Nor should it be done in the season of hatching, though done without fail every year, and the consequence will be, that your pigeon-house will be stored with prolific birds, and receive no annoyance from birds which have become barren. Perhaps a dozen of birds, male and female, so destroyed, may suffice at a time. On removing the stopping from the holes, and the slain birds, and closing the door, the creatures will be left in quietness.

(1705.) The daily treatment of fowls may be conducted in this manner:—Some person should have special charge of them, and the dairy-maid is perhaps the best qualified for it. As fowls are very early risers, she should go to the hen-house in the morning, on her way to the byre, and let out all the fowls, giving the hens and turkies a feed of light corn and cold boiled potatoes, strewed along at some convenient and established place out of the way of the general passage of horses and carts; such as between the hammels N, and the byre-court *l*, fig. 3, Plate III. The ducks should get the same food either near the horse-pond, or where there is a pond or trough of water, as they cannot swallow dry food without the assistance of water. Geese thrive well upon sliced turnips, a little of which, sliced small, should be left by the cattle-man for the dairymaid at any of the stores, and given at a place apart from the hens. When stated places are thus established for feeding fowls at fixed hours, they will resort to them at those hours; at least the well known call will bring the hour to their recollection, and collect them

together on the spot in a few seconds, and the regular administration of food being as essential for their welfare as that of other stock. Ducks pick up a good deal of what falls about the stable, and near the corn-barn door, as well as in the straw-barn; and geese will help themselves to the turnips that may chance to fall from the troughs of the cattle; and they are also fond of raw potatoes. After her own dinner, say 1 o'clock P.M., the dairymaid takes a part of the potatoes that have been boiled at that time, and while a little warm, gives them crumbled down, from their skins, with some light corn, to the turkies and hens. At this time of the day, the spaces below the stathels of the stacks in the stack-yard form excellent dry sheltered places for laying down food, and the stack-yard is a very probable place for their resort after their morning meal, especially when it rains or snows. In laying down food for the fowls, the pigeons should be remembered, as they will feed with the hens, and on the same sort of food. Before sunset, the fowls are all collected together by a call, and put into the house, and which they will readily enter; and many will have taken up their abode in it already, especially the turkies, which go very soon to roost. The ducks are the latest idlers. The floors of the different apartments should be littered with a little fresh straw every day, sufficient to cover the dung, and the whole cleaned out every week. Sawdust or sand, where they are easily obtained, forms an excellent covering for the floor of hen-houses. Troughs of water should be placed in the court-yard, and supplied fresh and clean every day.

(1706.) This mode of daily treatment will maintain fowls in a condition for using at any time, and it cannot be said to involve much expense, for the riddlings of potatoes boiled and light corn may be considered as the offal of the farm; but the truth is, food administered to these creatures at *irregular intervals*, though it be of the finest quality, will be comparatively thrown away, when compared to the good effects of food of even inferior nutriment given them at *stated hours*. This plan contrasts favourably with that which gives them large quantities of food at long intervals, and in an unpleasant state; and also with that which permits fowls to shift for their meat at the farmstead. Either of these ways will never fatten fowls; for food given in overabundance at one time, and restricted at another, can never *fatten* any animal; nor will they obtain sufficient food at all times when made to shift for themselves, because fowls are like all other animals, some can forage about most perseveringly, whilst others are indolent, and some careless of food when it is not placed before them. A regular plan is recommended, which is, always supply them with a certain quantity of food, ascertained by experience, and dependent on the nature of the flock; when this is repeated daily at stated times, their condition must increase,

because it cannot decrease, the minimum quantity of food being always sufficient to appease hunger; and this want they can never feel keenly when supplied with food at appointed times. Thus, in the long run, more nutriment will be derived from inferior food regularly administered, than from richer given irregularly. Should it be desired, however, to be particularly indulgent to fowls intended for immediate use, the following materials will render the respective sorts of fowls perfectly *ripe* in a short time. Boiled potatoes, warm, and light wheat, for hens; boiled potatoes, warm, and firm oatmeal porridge, warm, for turkies; boiled potatoes, warm, and oats, for geese; and boiled potatoes, warm, and boiled barley, warm, for ducks. The potatoes and porridge should be crumbled down in small pieces. But *immediate* effects, even from superior food, can only be expected on fowls that have been regularly fed as recommended above, up to the time the superior food is indulged in. Let starved fowls receive the same ingredients, and a long time will elapse ere they exhibit symptoms of improved condition, besides the risk they run, in the mean time, of receiving injury from surfeit and indigestion. No doubt, superior feeding would incur cost, if persevered in throughout the season; but I am not disposed to deny, that were proper breeds of fowls only cultivated, and the shortness of time taken into consideration in which a pure breed will *ripen* upon it, that profit would be derived from its use. The experiment has never been satisfactorily attempted by the farmer, and all the accounts we know of superior feeding, apart from experiments by men of science, are only derived from the establishments of noblemen, whose object is not to obtain profit, but the possession of a superiorly fed animal.

(1707.) Other ingredients may be and are used for the feeding of fowls, among which may be mentioned brank or buck-wheat, rice, and Indian corn. Buck-wheat is successfully grown in England, not so in Scotland. It is said to fatten poultry well, though not so well as grain. Rice may be given either raw or boiled; in the former state, fowls will pick it as readily as grain after feeding on boiled potatoes, and, when boiled, it will fatten without the aid of potatoes, but, of course, it is more expensive, as even *good* damaged rice can seldom be obtained under 16s. or 18s. per cwt., which is nearly 2d. per lb., without the expense of cooking. Fine barley, weighing 56 lb. per bushel, selling, as it is at present, at 3s. 6d. per bushel, is only $\frac{3}{4}$ of a penny per lb. Indian corn is employed in America, in the southern parts of Germany, and in Lombardy, for feeding poultry, and they become very fat upon it. It is too large to be swallowed raw, like the horse-bean of this country, but when steeped in water, or boiled, it is easily eaten. If sold at even 8s. per

bushel, its cost would be under 2d. per lb. "From a desire to save expense," says Boswell, "the bran of wheat, and sometimes pollard, or middlings, are given to fowls; but these bruised skins, where little if any of the farina of wheat remains, appear to contain a very small portion of nourishment in proportion to the cost price. M. Reamur found by experiment, that it is little or no saving to substitute bran for good grain in feeding poultry. Bran is not given dry, but mixed with water to the consistence of paste. Some people boil this; but it does not increase the bulk, except in a very trifling degree, and is, therefore, of small advantage. He found that 2 measures of dry bran, mixed with water, were consumed by fowls in the same time that they would have eaten a single measure of boiled barley, equivalent to $\frac{2}{5}$ of a measure of barley." * Bran of itself, therefore, it appears, is of no use to fowls as food; but it may be made the means of conveying nourishing food to them, in the shape of fat, broth, and other rich liquids from the kitchen, which they could not otherwise avail themselves of but through such an absorbent. Fowls are very fond of bread, and even of butcher-meat, cooked or raw; and they will pick a rough bone very neatly. They sometimes also display carnivorous propensities. Many a time have I observed them watching for a mouse at the casting down of a stack in the stack-yard; and the moment one was seen to escape, away they would run, cocks and hens together, in full chase after it; and on mobbing it, peck it not only to death, but to pieces, and then swallow it.

(1708.) I have said that *eggs*, and chickens too, may be obtained in winter by good management. The young hens of the first broods in April will be old enough to lay eggs in winter. A few of these should be selected for the purpose; and when the period of laying approaches —which may be ascertained by their chaunting a song and an increased redness of the comb—they should be encouraged by better feeding and warmer housing at night. The feeding consists of warm potato and firm oatmeal porridge twice a-day,—at morning when they are let out, and in the afternoon at 1 o'clock. To give them peace in feeding upon their more tempting fare, they may be fed by themselves in the court-yard of the hen-houses, and the door shut upon them after the rest of the fowls have left their night's quarters. And their more comfortable housing consists in directing them into the hatching-house betimes every afternoon, and therein making for them a number of comfortable nests of clean oat-straw, to choose amongst; and when they have taken to the one each selects for her own, leaving an old egg in it for a nest-

* Boswell's Poultry Yard, p. 54.

egg. These three or four young hens will lay as many eggs every day; and though they are not so large as those of more matured fowls, being only pullets' eggs, still they will be fresh; and it is no small luxury to enjoy a new-laid egg at breakfast every winter-morning—a luxury which I enjoyed for as many years as I lived in the country.

(1709.) With regard to *young broods in winter*, I believe few people will impose upon themselves the trouble of setting hens on eggs so late in the season for the purpose of rearing chickens in winter; and yet it may be done without difficulty; but sometimes the task is imposed involuntarily upon one, inasmuch as some hens will secrete their nests in the fields, amongst corn, or at a hedge-root, or other safe place, and bring out strong broods of chickens on the eve of winter. In such an event, the little innocents, brought into a cold world, cannot be allowed to perish merely for want of care. When such a brood makes its appearance, or is purposely brought forth, it should be kept apart from the rest of the flock, in a warm and sheltered place; and where no better place presents itself, it may be comfortably housed in a corner of the boiling-house (U, fig. 4, Plate IV.), where a hamper or basket, placed over mother and chickens, or a fence of some kind, erected across a corner, near the fire, will protect them from external danger. From thence they should be let out in the forenoon, to enjoy the air and bask in the sun, and be returned to their shelter long before sunset. In rainy weather, they should be conducted to a shed; and in hard frost, they may be kept in the house altogether, as frost soon benumbs their legs, and if they lose the power of which, they will soon droop and die. A nest of straw, elevated some inches above the floor, to keep them above the draught of air that sweeps along the floor, and having a broad base to afford the chickens an easy access to their nest, should be formed, for the hen to brood them on at night; and when fresh litter is given them every evening, a little of the cleanest and warmest to be found under a cow in the adjoining byre, where she has lain, will be most acceptable to the tiny limbs of the active brood. Food should be given them from morning to evening every three hours. It may consist of warm boiled mealy potatoes crumbled down small, picks of oatmeal porridge, mealy boiled potatoes warm, mixed with oatmeal, and a flat dish of clean water. With a little variety of food, daily attention, and temperate housing, they will get on well, and by spring be as plump as partridges, and as valuable as ortolans. I am surprised to observe Mr Mowbray say, that "to *attempt* to rear winter chickens in this climate, even in a carpeted room, and with a constant fire, would in all probability be found abortive. I have repeatedly made the experiment,"

he adds, "with scores, without being able to preserve an individual through the winter."* The difficulty I consider small, though the trouble may be unnecessary, but neither a "carpeted room," nor a "constant fire," will assist much in the rearing of chickens, the whole secret of the art consisting of suitable food, moderate degree of temperature, fresh air, and constant attention.

(1710.) Such is the way I would recommend the feeding of poultry on a farm. It is not an expensive mode in a pecuniary point of view, consisting entirely of ordinary fare, and regular attention; and therein consists the entire value of the plan. That the plan is valuable and worthy of imitation has been proved beyond doubt, by its supplying fowls of every kind in their respective seasons, in high condition—at any period of the season they were required—and without any previous formal preparation. Thus, a chicken, a young cock, a hen, were at command throughout the year; a duckling throughout the autumn; and a goose or a turkey from Michaelmas to March; and this not for one year, or only in a favourable season, but year after year for 15 years, as long as I had opportunity to practise it. In short, a *young* fat fowl and a fresh egg were never awanting, from January to December; and there is a great deal of truth in Cobbet's remark, where he says, "one thing about fowls ought always to be borne in mind. They are never good for any thing after they have attained their full growth, unless they be capons or poullards."†

(1711.) In regard to the undue means used for pampering fowls to fatness, I quite agree with Cobbet that "crammed fowls are very nasty things;" and when we reflect on the worse than imprisonment practised for the purpose, by cooping up fowls in the dark, and tying their feet together, the means used to attain the end becomes reprehensible. Liebig explains the rationale of this latter practice. "Experience," he says, "teaches us that, in poultry, the maximum of fat is obtained by tying the feet and by a medium temperature. These animals, in such circumstances, may be compared to a plant possessing in the highest degree the power of converting all food into parts of its own structure. The excess of the constituents of blood form flesh and other organized tissues, while that of starch, sugar, &c., is converted into fat. When animals are fed on food destitute of nitrogen, only parts of their structure increase in size. Thus, in a goose, fattened in the method above alluded to, the liver becomes three or four times larger than in the same animal, when well fed with free motion, while we cannot say

* Mowbray's Practical Treatise on Domestic Poultry, p. 57.

† Cobbett's Cottage Economy.

that the organized structure of the liver is thereby increased. The liver of a goose fed in the ordinary way is *firm and elastic;* that of the imprisoned animal *soft and spongy.* The difference consists in a greater or less expansion of its cells, which are filled with fat."* This practice appears to me the more reprehensible, in that its principal effect is to increase the bulk of offal only.

(1712.) *Peacocks* may be treated in the same manner as turkeys; and as to guinea-fowls, notwithstanding the deliciousness of their eggs, they should never be tolerated in a farm-yard, both on account of the horrid noise they make, and of the strong propensity they always evince to annoy other fowls.

(1713.) The *feathers* of the various sorts of fowls used, are either disposed of or converted into domestic use. The following directions on sweetening and managing feathers are given by a notable housewife of my acquaintance; and as they very nearly accord with my own experience, I shall transcribe them in her own intelligent words. "Every one is aware that the feathers of cocks and hens are very inferior to those of geese and ducks, for the purpose of filling beds and pillows; and, consequently, it is scarcely necessary to mention, that the former should be kept separate from those of the two latter fowls. As the birds are plucked, the large feathers should be selected and placed asunder. Paper-bags are the best recipients. The pinion feathers should be stripped from the quill, and added to the other feathers; and, if great caution have not been used in plucking the birds, they should be carefully looked over, that no part of the skin has been torn and adhering to the base of the quills. The bags of feathers should be placed in the bread-oven on the day after it has been heated, and, after some hours, removed to a dry airy place; and this ought to be done every week." On this part of the subject, I may mention a less troublesome plan than the oven, where the adjoining apartment, behind the kitchen-fire, is not in constant use, which is, that, in such a situation, feathers may be hung up in bags against the wall behind the fire, and there they will soon win. "Notwithstanding," continues our instructress, "every apparent caution shall have been used, the feathers are frequently found to be tainted, either from carelessness in plucking, or by neglecting to attend to them afterwards; and no *subsequent baking or picking* will be found available to restore them. In this case, the only method to render them sweet is to boil them, which is to be effected in the following manner: One or two large canvass or calico bags must be made, into which the feathers from the small paper-bags must be emptied and tied up; a washing-copper must be nearly filled with rain-water, and

* Liebig's Animal Chemistry, p. 94.

made to boil. The calico-bags, then, one at a time, are to be dipped, and, by means of a stick, pushed about, and squeezed, and kneaded, for the space of four or five minutes, then lifted out and taken out of doors, and being tied together and the openings kept secure, that no feathers may escape, they must be hung over a line, and left to drain and dry. Several times a-day the bags are to be shaken up and turned over; and as soon as the feathers appear to be light and drying, which will not be the case for nearly a week, the bags must be hung up during dry weather only, and taken in every night. In about a fortnight, the feathers will become perfectly sweet and ready for use; and the water in which they were boiled will sufficiently indicate that this plan was not only necessary, but efficacious, in cleansing them from impurities which would else have rendered them useless." As an attestation of the practical efficacy of the plan, the lady adds, "having tried the method ourselves, we can assure our readers of its eligibility." *

(1714.) In regard to the *diseases* of fowls, I can safely say, that, if fowls are attended to in a systematic manner, with wholesome food prepared for them every day, and their roosting place kept clean and airy, very few diseases will affect them at any age. Although there is truth in the observations of Mr Mowbray, when he says, that "The diseases of our domestic animals kept for food are generally the result of some error in diet or management, and should either have been prevented, or are to be cured most readily and advantageously by an immediate change, and adoption of the proper regimen. When that will not succeed, and farther risk is extremely questionable, and particularly with respect to poultry, little hope can be derived from medical attempts;" † yet I am not of the opinion, that, when fowls are observed to be affected by any disease, a mere change of regimen will readily effect a cure. On the contrary, the value of the animal is lost in the time permitted the disease to develop its symptoms. The plan, therefore, that averts the greatest amount of loss in the animal itself, and of expense in the attempt to cure its disease, is to kill the animal the moment the least symptom of disease is seen to affect it. If a fowl is found "in a corner" pining away, the fault lies with those who have the charge of it; for if they fulfilled their duty in daily noticing, as they ought to do, the state of every creature under their charge, none could stray away from the rest under the effect of disease, or any other cause, without being immediately missed and searched for.

(1715.) *Sniffters.*—The only disease I can remember to have seen in winter is what is vulgarly called the *sniffters*, that is, a discharge of matter from the nose, which causes a noise in the nose like stifled breathing. It is evidently a catarrhal affection, and has most probably been superinduced by exposure to rain or cold in a stormy day. When first observed to be affected with this complaint, any fowl kept in the condition it should be, may be used without scruple, which is a much better plan than tormenting the animal by pursuing the usual prac-

* Quarterly Journal of Agriculture, vol. x. p. 480–1. There is a curious account given, in Head's Home Tour, of the modes of plucking feathers off fowls of various kinds in a large poulterer's establishment in Lincoln.

† Mowbray's Practical Treatise on Domestic Poultry, p. 211.

tice of thrusting a feather through its nostrils. If the fowl is not fit for killing, the fault lies either with the person who has charge of the poultry, or with the farmer himself, who grudges the creature its food.

(1716.) *Lice.*—Every fowl is affected with lice. The common hen is infested by more than one pedicular inhabitant, but the most frequent is the *Lipeurus variabilis*, which has a narrow body, the head rounded in front, the general colour dirty white, smooth and shining, the margins with a black band, the abdomen having a brown interrupted stripe down the middle. According to Mr Denny, our principal authority on this subject, it prefers the primary and secondary feathers of the wings, among the webs of which it moves about with great celerity. *Menopon pallidum* is almost equally common in poultry, running over the hands of those who are plucking them, and difficult to brush off from the smoothness of their bodies.

(1717.) The peacock has a large and very singularly formed parasite of this nature, named *Goniodes falcicornis;* and another, not unlike it in general appearance, occurs plentifully on the turkey.

(1718.) Geese and ducks are infested by similar foes, particularly the latter, on which the *Docophorus icterodes*, a species common to the whole anserine tribe, is usually very abundant.*

(1719.) *Goose fat* is used for some purposes on a farm. It is useful in anointing the udders of cows in spring, should they become hard, as it has the property of resisting evaporation for a long time. It also keeps a poultice moist until it should be renewed. And, on account of this property, it constitutes a good ingredient of grease for smearing the axles of cart-wheels. This fat may be *rendered* in the same manner as mutton-suet and lard (1413.), and kept in a jar covered with bladder. Goose fat " is colourless, and has a peculiar taste and smell, rather agreeable. If melted, it congeals at 80½° Fahr. into a granular mass, having the consistence of butter. When exposed to pressure between folds of blotting paper at 28½°, it is resolved, according to Braconnot, into

	Goose fat.	Duck fat.	Turkey fat.
Stearin, . .	32 fusible at 111°.	28 fusible at 126½°.	26 fusible at 113°.
Elain, . .	68	72	
	100	100	100†"

(1720.) In regard to the right of farmer's shooting pigeons, it has been decided that " The tenant was found not justified in shooting his landlord's pigeons, on the allegation that they destroyed his crops. (Easton, May 18, 1832; 10 S. D. 542.)" ‡ This decision proves the fallacy of a common opinion, that a farmer may shoot pigeons in the act of destroying his crops, provided he does not carry them away after they are shot. If this opinion were supported by law, any tenant that had a grudge against his landlord might lure his pigeons by various means to a particular spot, and there shoot them, and let them lie.

* Denny's Monographia Anoplurorum Britanniæ.

† Thomson's Animal Chemistry, p. 138.

‡ The Farmer's Lawyer, p. 35.

39. OF THRASHING AND WINNOWING GRAIN, AND OF THE THRASHING-MACHINE.

"While wind and rain drive through the half-stripped trees,
Fanners and flails go merrily in the barn."

GRAHAM.

(1721.) THE first preparation made for *thrashing* corn—that is, separating the grain from the straw by the thrashing-machine or the flail—is casting in the stack to be thrashed, and mowing it in the upper or thrashing-barn. The person appointed to superintend the barn-work, is the one who *casts* down the stack to be conveyed into the barn. This one is generally the steward, where such a functionary is engaged; and when there is no steward, the person who superintends the field-workers usually takes the charge. In some cases the hedger does it, when there is not much field-work in winter, such as water-tabling old hedges, or planting new ones. Suppose, then, that the steward undertakes the duty. He is assisted in it by 4 field-workers.

(1722.) When about to *cast* a stack, he provides himself with a ladder to reach its eaves, and a long small fork usually employed to pitch sheaves

Fig. 302.

CASTING IN A STACK TO BE THRASHED.

at leading-time to the builder of stacks. He also provides himself with a stout clasp knife, which most farm-servants carry. Standing on the

ladder, he, in the first place, cuts away with the knife all the tyings of the straw-ropes at the eaves of the stack. On gaining the top, the ladder is taken away, and he cuts away as much of the ropes as he thinks will allow him to remove the covering with the fork. The covering is then pushed down to the ground, until the top of the stack is completely bared. On the side of the stack nearest the barn, a little of the covering is spread upon the ground by the field-workers, to keep the barn-sheet off the ground, and they spread it over the spread straw, close to the bottom of the stack. This *sheet* consists of thin canvass, about 12 feet square. The sheaves first thrown down from the top of the stack upon the sheet are taken by the women, and placed side by side, with the corn end upon the sheet, along both its sides, to keep them down from being blown up by the wind, or turned up by the feet. The sheet is seen spread out at *a*, fig. 302, from the base of the stack *b*, which is in the act of being thrown down by the steward, whose figure may be supposed to be represented at *c*, and the sheaves, keeping down the sides of the sheet, are seen lying in a row from *d*, represented, however, rather too much to the left. The machine used for conveying away the sheaves to the barn is the *corn-barrow*, fig. 303, the construction of which is so ob-

Fig. 303.

THE CORN-BARROW.

vious that a specified description seems unnecessary, farther than that it is about 6 feet in length, and stands 2½ feet in height at the highest part. The sheaves are laid *across* the barrow, in rows, with the corn and butt ends alternately, and they are kept from sliding off in the act of being wheeled, by the slanting back of the barrow, which is supported by stays. In this way, from 10 to 15 sheaves, according to their bulk, may be wheeled away at once by a woman. One barrow *e*, fig. 302, is in the act of being loaded by the field-worker *f*, whilst another worker *g* assists in loading every barrow as it returns empty; and another barrow *h* is seen fully loaded, and in the act of being wheeled away by a third field-worker *i* to

the barn. Each barrow-load, as it arrives at the upper barn, is tilted upon the floor, and emptied at once, instead of the sheaves being lifted out of it one by one. Two barrows, if the distance from the barn is not great, will bring in a stack of ordinary size in a moderate time, say in 3 hours. A fourth worker remains in the upper barn, to pile up the sheaves as they are brought in into what are called *mows*, that is, the sheaves are placed in rows, parallel to each other to a considerable height, with their butt ends outwards, the first row being piled against the wall, as partially seen at *a*, fig. 304. In casting the stack, the steward takes up the sheaves in the reverse order in which the builder had laid them at harvest time, beginning with those in the centre first, and then removing those around the circumference one by one. The fork thrust into the band will generally hit the centre of gravity of the sheaves, where they are most easily lifted, and swung towards the sheet. The sheaf *k*, fig. 302, is about the position it assumes on being pitched by a fork, the corn end always having a tendency to drop downwards, and it is supposed to have been lifted from its bed at *l*. When all the sheaves of the stack have been wheeled in, the steward takes the rake *b*, fig. 304, and clears the ground of all loose straws of corn that may have be-

Fig. 304.

FEEDING IN CORN INTO THE THRASHING-MACHINE IN THE UPPER BARN.

come scattered around the base of the stack, and puts them into the sheet, the four corners of which are then doubled in towards the middle, including within them the grain that may have been shaken out by the shock received by the sheaves on being thrown down; and the sheet, with its contents, are carried by all the women into the barn, and its contents emptied on the floor, near the feeding-in board *c*. The sheet is then shaken, and spread out upon the stack-yard dyke, or other airy

place, to dry before being folded up to be ready for use on a similar occasion. The covering of the stack is then carried away by the women, to such parts of the courts and hammels as are considered by the cattleman to require littering, before it becomes wetted with rain, and the ground raked clean. The straw-ropes, which bound down the covering of the stack, should be cut by the steward *into short lengths* before being carried away in the litter, as *long* ropes are found very troublesome to the men when filling their carts with dung on clearing out the courts. Stacks should be carried into the barn in dry weather, though a drizzling or muggy day will do little harm to the straw. Damp straw is passed through the thrashing-mill not only with difficulty, but is apt to mould and contract a disagreeable smell in the straw-barn. A stack may remain in the barn until the straw is required; or it may be thrashed the first wet day; or it may be required to be thrashed on the subsequent part of the day in which it is carried; or it may be requisite to thrash it as brought in, in which case additional hands are required to bring it in, while the usual barn-workers are employed at the mill. The steward having to feed in, the hedger, or engine-man, or one of the men, should field-work not be pressing, or even a woman, in that case, can cast the stack, provided the covering is taken off for her, which the steward should do ere the mill is set on. Two barrows actively worked will keep the mill going, if the distance from the stack to the barn is moderate.

(1723.) Another mode of taking in a stack into the upper barn is with a horse and cart. When this plan is adopted as a fixed plan, there is no gangway to the upper barn, the cart being set alongside the wall, and the sheaves forked into the door upon the floor, from whence they are carried to the mow. This plan also requires the stackyard to be constructed so as a cart may pass and turn between every two rows of stacks, thereby causing it to occupy a large space of ground. It has also the effect of laying a plough idle when a stack is taking in, unless there be an odd horse, worked by a lad, employed, over and above the ordinary number of draughts. If a plough is laid idle upon every stack taken in, there will be much greater loss incurred by employing the horses in this way, than in paying 4 women, and having 2 barrows; and, after all, the women will be required to work in the barn when the mill is set on. When a horse is employed, 2 men are required at the taking in the stack; one to cast the stack, and the other to drive the horse, unless, indeed, a woman is employed to cast the stack, which she may do occasionally, but cannot be depended on to have the requisite strength for doing that work throughout a season. On taking in with a horse, one

barn-sheet is required at the stack and another at the barn-wall. The cart-wheels are apt to cut up the stackyard in wet weather, unless the roads through it are metalled with stones, which incurs expense; and in time of snow, a complete road must be cast for the passage of the cart. Roads through a stackyard, to admit carts everywhere and give freedom to go to the barn from any part of it, lays the stackyard open to people and stock. I confess I like the gangway (as at T, figs. 3 and 4, Plates III. and IV.) and the barrows, as being a neater and quieter mode of proceeding with the work, especially as women are obliged to be employed in the barn; but even with a gangway, a cart or carts may be employed in taking in a stack while the mill is going, by their entering the stackyard by the ordinary gate; and the sheaves can be forked from the cart, across the gangway, into the upper barn, and thence taken to the mow or feeding-in table.

(1724.) Before setting on the thrashing-mill, its several parts require to be *oiled*. Fine sweet oil should be employed for this purpose, though too often a coarse dirty oil is used. It should be put for use into a small tin-flask, having a long small spout, to reach any gudgeon behind a wheel. The gudgeons which require oiling are those of the drum, the spur-wheel, the shakers, and the fanners; and, with horse-power, that of the pinion of the lying shaft; and, in the case of water-power, those of the wheel, and the lying and upright shafts. It is the duty of the steward to oil the machine. When steam is employed as the moving power, the fire should be kindled by the engine-man in time to get up the steam by the moment it is wanted. When water is the power, the sluice of the supply dam should be drawn up to the proper height, to allow the water time to reach the mill-wheel sluice when it is wanted. When the power is of horses, the horses are yoked in the wheel by their respective drivers, immediately after leaving the stable at the appointed hour of yoking, and while one of the men is left in charge of driving the horses, the others go to the straw-barn to take away the straw from the screen of the mill with the straw-fork, fig. 279, and fork it in mows across the breadth of the barn. A woman is appointed to tramp the straw, spread it regularly over the mow that is forming, and to form one mow after another. I say nothing in regard to the arrangement made when the moving power is wind; for, of a certainty, another windmill will never be raised in this country in connection with a thrashing-mill. The steward undertakes the feeding-in of the corn, and has the sole control of the mill. Two women are appointed to the upper barn, to bring forward the sheaves, loosen their bands, and place them, as required, upon the table attached to the

feeding-in board. Other two women are appointed in the corn-barn to take away the corn as it comes out of the spouts, and riddle it with riddles appropriate to the sort of corn about to be thrashed. Where elevators are in use, one woman is sufficient in the corn-barn to riddle the corn as it comes out of the clean spout, and the other woman, in this case, tramps the straw-mow in the straw-barn. Where there are no elevators, a second woman is required to riddle the roughs from the foul spout into a heap by itself. It is the duty of one of the women in the corn-barn to see that the chaff does not accumulate upon the end of the mill-fanners, and fall down into the rough spout. To ascertain the state of the chaff easily, a small sliding shut should be made in the partition between the corn-barn and chaff-house, on opening and looking through which, the state of the chaff will at once be seen. When water or steam is employed, either women are appointed to take away the straw from the machine, independent of those in the barns; or men are appointed to do it, such as the hedger and cattle-man, and at times the shepherd.

(1725.) Every thing being thus prepared (and every preparation ought to be completed before the mill is moved), the mill is ordered by the steward to be set a-going by the engine-man or driver, when the power is steam or horses, and he himself lets on the water to the wheel when the power is water. The power should be applied gently at first, and no corn should be presented until the mill has acquired its proper momentum, the *thrashing-motion*, as it is termed. When this has been attained, which it will be in a very few seconds, and which a little experience will teach the ear to recognise instantly, the steward—the feeder-in—takes a portion of a sheaf in both his hands, and letting its corn end fall before him on the feeding-in board, spreads it with a shaking and disengaging motion across the width of the board. His great care is, that no more is fed in than the mill can thrash cleverly; that none of the corn is presented sideways, or with the straw end foremost. He thus proceeds with a small quantity of corn for a few minutes, until he ascertains the capacity of the mill for work at the particular time, when the quantity required is fed in; but this, on any account, should never exceed one sheaf at a time, however fast they may have to be supplied in succession. The ascertainment of the capacity of the mill is necessary every time the mill is used, and however well acquainted the feeder-in may be with it, for whatever the power employed may be, it is not alike powerful under different circumstances. For example, the water may flow quicker or slower; the horses move more slowly and dull or brisker; and the steam act more or less powerful one day than in another. If water is flowing *freely into* the supply-dam while the

thrashing is going on, it will come more quickly towards the wheel, and consequently maintain the thrashing pace of the mill for a longer time than when it flows from a full dam until it is emptied. So with horses; the state of the weather will oppress them one day, and they will work with languor and irregularity, do what the driver can to induce them; while in another day, they will work with an active pace throughout the yoking. I presume less of this variation will be felt with steam than with any of the other powers, but still the state of the atmosphere may have *some* effect on its elasticity; but with the management of steam-power I am practically unacquainted. Proceeding in this way, the feeder-in *d*, fig. 304, takes the sheaves from the table *e*, which are supplied him by a woman stationed beside it *f*, whose duty it is to loosen the bands of the sheaves; but he should not allow her to put on more than one sheaf at a time on the table, as is the propensity to do, much to his annoyance in separating them; while the other woman *g*, brings forward the sheaves, and places them in a convenient position before the other woman *f*, and even loosens one occasionally in assistance.

(1726.) There are two circumstances which greatly affect the regular action of the mill in horse-power, and the cleanness of thrashing with any power. The first is the mode of *driving the horses*, in which a considerable difference is felt when one man keeps the horses at a regular pace, whilst another drives them by fits and starts. The regular motion is affected by the man walking round the course in *the contrary direction to the horses*, in which he meets every horse twice in the course of a revolution, and which keeps the whole upon their mettle, every horse expecting to be spoken to when he meets the driver. The irregular motion is produced by the man walking in the *same direction* with the horses, when the horse next him only makes the greatest exertion until he outstrips the man, and then slackens his pace; then the horse that follows him, coming up to the man, exerts himself until he also passes him; and so on in succession with every horse. The man in such a case always walks slower than the horses; and when he gives a crack of the whip, all the horses give a start, and, of course, strain the machine; but immediately after, they relapse into their usual dogged walk. In such a style of driving, a willing horse is apt to get more to do, and a lazy one less than it should, as horse-wheels are usually constructed. The gangway, which is sometimes made for the driver to walk in, in the framing of the wheel, serves only to encourage his indolence. I have seen a fellow fast asleep while leaning against one of the stays of the wheel, and while being carried round on the gangway.

(1727.) One cause of foul thrashing is cutting the bands of the sheaves

with a knife, instead of loosening the band and corn-knot. The cutting is a quick mode of relieving the woman who hands the sheaves to the feeder-in, but the knot, of course, passing sideways with the sheaf, almost escapes the drum. Every band should be loosened, its corn-knot untied, and laid along the sheaf to which it belongs, when it will have the chance of being thrashed clean. If one woman is unable to loosen the bands on account of the shortness of the sheaves, the other woman should assist her to do it, by laying loosened sheaves before her, but if a third woman is required for the work, let her be supplied rather than the corn be not thrashed clean.

(1728.) The state of the corn in reference to dryness or dampness, and lengthiness and shortness of the straw, as well as incidents in the moving power, will very much affect the progress of thrashing. When the sheaves are long, the feeding-rollers will of course take a longer time to take them in; and to make them take in faster, the fast motion should be given to them. A slower motion than requisite is apt to chop the straw in pieces by the scutchers of the drum. On the other hand, short sheaves may be taken in so quickly, as not to afford the drum the requisite time to separate the corn from the straw; in which case the rollers should be put upon the slow motion. It is a laborious task to feed in short sheaves of any sort, and especially oats, so as to keep the mill a-thrashing, and it is loss both of time and power to allow the feeding-rollers to have nothing to do even for a moment. I was once dreadfully worked in feeding-in a stack of ordinary dimensions of Blainslie oats, and so were the women who loosed the sheaves and riddled the corn; owing to the shortness of the straw, when the sheaves disappeared through the feeding-rollers in an instant, though on the slowest motion. The stack took about 6½ hours to thrash with horses, and during this time 64 bolls, or 384 bushels, of clean corn passed through the mill; nearly 10 bolls or 60 bushels an hour. Another cause besides short straw, may cause great labour in feeding-in, namely, an inordinate application of the moving power. Wind is the power which is most likely to pass from under the control of man. I remember of a windmill which ran off, and could not be stopped by the brake, in consequence of a sudden gale pressing more forcibly upon the sails than it was in the power of the apparatus to furl them; and such was the velocity of the mill, that it required two men to feed in, and horses and men were obliged to be employed to bring in sufficiency of corn to supply the machinery until the wind should abate, which it did not until three large stacks of oats had been thrashed, and at the rate of 16 bolls or 96 bushels per hour. Sometimes the straw winds around the upper feeding-roller, and, when

it does, no more corn should be put in, as it will be drawn in instantly by the drum. In some mills a reverse motion is given to the rollers to obviate such an accident, namely, to unwind the straw; but it does not always serve the purpose intended. Indeed, I never saw any thing like a complete instance of unwinding. A much better plan, therefore, is, to cut off the straw with a stout knife, while the rollers are moving in their usual course. The most convenient form of knife is that of a razor set dead in a stout wooden handle. It should be kept at hand by putting it through a leather slip nailed on the inside of the post of the drum-framing, near the right hand of the feeder-in. Long oat-straw is liable to warp at all times, but especially when wet, and more especially still when it is led-in in a damp state direct from the field. The direction and strength of the wind, independent of the wind-mill, affects the progress of thrashing. When the wind blows in the direction of the length of the mill—if it blow in the direction the straw passes through it—thrashing will proceed briskly and cleanly. So powerfully have I seen this circumstance accelerate the progress of the straw, that the upper barn-door had to be shut to moderate the effect. On the other hand, when the wind blows from the straw-barn through the mill, against the straw, the progress of thrashing is much retarded; so much so, that the straw-barn doors have all to be closed; but although this is done, the thrashing will never be done cleanly, much of the corn being apt to be drawn over the straw-screen. Some mills are closed in with boarding over the drum-cover, and the rake concealed from view, but in a close muggy day, with the straw not completely dry, the straw is apt to linger about the rake, and to obviate this inconvenience, the board is raised up; but if wheat is thrashing, its removal causes another inconvenience, namely, the striking of the grains of wheat from the surface of the rake upon the face of the feeder-in, occasioned by the force with which the grains are impinged by the drum. So painfully have I felt the pellets of wheat strike my face, that a sack had to be put up to protect it, when some of the space was left open for the air to get to the straw. This inconvenience from the straw, I have seen most frequently when seed-wheat was thrashing in autumn, before the straw was completely won; and wheat-straw, in this state, will wind round the rollers.

(1729.) When horses are employed, they generally get a breathing of about 15 or 20 minutes at mid-yoking. When the sheaves are about all thrashed, one of the women takes the rake, *b*, fig. 304, and pushes with its inverted head all the loose corn along on the floor that has come out from the straw, into a heap at the feeding-in board, upon which it is placed by the other woman with the wecht *h*. While the

feeder-in is putting this short stuff towards the rollers with a stout stick, kept in the barn for the purpose, the woman who had raked it in, now sweeps the floor towards the board, with the besom *i*. The mill is then stopt for a few minutes, until all the corn, chaff, and straw belonging to the particular stack thrashed is swept away from the drum-gudgeons, and elsewhere, and placed on the feeding-in board, that no remains of the kind of corn in hand may be left to mingle with perhaps a very different sort of grain of the succeeding stack. While all this has been proceeding, the women in the corn-barn have not been idle. One has riddled the corn as it came from the clean spout against a convenient part of the barn-wall; while the other has riddled the roughs from the other spout, first having laid down a small barn-sheet, upon which the rougher part that is left in the slap-riddle is thrown, and taken up to the upper barn, and passed again through the mill. Where elevators and fixed fanners are in use, one woman is sufficient in the corn-barn, to riddle the corn from the clean spout upon the endless web of the fanners.

(1730.) When barley is thrashed, the roughs are not riddled as it comes from the spout, but reserved to be put through the mill after the sheaves have been all thrashed. For this purpose, the hatchway *a*, fig. 16 (56.), is a convenient means of communication betwixt the corn and upper barn, and through which the roughs are handed up in wechts, and placed on the feeding-in board, from which the feeder-in supplies the mill in small quantities with the stick, so as the roughs may have time to be thoroughly scutched by the drum; for, with the exception of the fanners to blow away the awny refuse into the chaff-house, the rest of the machinery of the mill is of little value in this operation. The use of the stick for this and the operation mentioned above, is to save the hand of the feeder-in being seized by the feeding-rollers, when feeding-in so short a substance as roughs. Few mills have elevators, and therefore the barley-roughs are usually treated as now described. When any portion of the straw happens to be damp, which it is very likely to be immediately after harvest, the probability is that the corn will not be thrashed clean out of it, and it may be advisable to put that portion again through the mill. For this purpose, the opening in the wall at *b*, fig. 16 (56.), betwixt the upper and straw barns, permits the damp straw to be forked up from the straw to the upper barn through *b*. After all the use is made of the mill for the time, the sluice of the dam is let down, the horses taken out of the mill-course, or the steam let off, the hatchway and opening closed, and the door of the upper-barn locked.

(1731.) I have said that the straw, as thrashed, is mowed up in the straw-barn; but there is a plan of saving the cattle-man some trouble

in carrying litter when the courts and hammels require to be littered, which is, to carry the straw, as thrashed, into the several places requiring it. To effect this, the straw is carried in back-loads from the screen in short ropes, one end of which is hooked on to its bottom, while the other end is held in one hand of the person who is to carry the load, and the other hand guides the straw into the rope. Those who carry assist each other on with the load in the barn.

(1732.) The next process in connection with corn is the *winnowing* it, that is, making it clean for the market, and this process is conducted in the corn-barn. There are two ways of conducting this process; one when there are no elevators, and no fixed set of cleaning fanners; the other when there are both. I shall first describe the process when there are no elevators and fixed fanners. The first thing to be done towards preparing the thrashed heap of corn for the market, is passing the roughs through the blower, or winnowing-machine, or fanners. This machine is set with its tail at the barn-door, that the chaff blown away may fall upon the causeway of the court K, and be kept out of the corn-barn. The steward drives the fanners, one woman fills the hopper with the roughs, either of wheat or oats, for the barley roughs, as you have seen, have been put through the mill again; and as roughs do not pass easily through the hopper, another woman stands upon the stool belonging to the barn, and feeds them in with her hand towards the shoe or feeding-roller, while the other two women riddle the corn upon the heap that had been riddled from the clean spout of the thrashing-mill. The riddlings of the roughs, and all the light corn, may be put into an enclosed space, such as is shewn at the bottom of the granary stair in the corn-barn, fig. 2, Plate II., for the fowls.

(1733.) This matter being disposed of, the heap of grain, suppose it to be wheat, is next to be winnowed. For this purpose, the blower is placed alongside the heap, with its tail away from the direction in which it is proposed to place the new riddled heap of grain with its offside, that is, its side farthest from the driver, next the heap. The steward adjusts the component parts of the blower to suit the nature of the grain to be winnowed, namely, the tail-board should be no higher up than to allow the chaff to escape over it, while it retains the lightest even of the grain: the slide in the interior should only be so far up as to permit the light grain to be blown over it, while it retains all the heaviest, which pours down onwards to the floor. What falls from this slide is the light corn, and it drops nearest the chaff. The wire-screen below this slide permits dust and small seeds of wild plants to pass through, and deposites them between the light and heavy corn. The opening at the feed-

ing-roller is so adjusted as that the grain shall fall as fast, but no faster than the wind shall have power to blow away the chaff and light corn from amongst the heavy. All these adjustments of parts may not be made the most perfect at once, but a little trial will soon direct him what requires to be rectified, and experience of the machine will enable him to hit near the mark at once. The blower should be made to stand firmly and steadily on the floor when used.

(1734.) The arrangement of persons for winnowing corn, so as to proceed with regularity and dispatch, is this:—The steward drives the blower. One woman fills the hopper with corn with a large wecht from the heap, on the opposite side from the driver. Her duty is to keep the hopper as nearly full as she can, as then the issue of corn from it is most regular. Another woman, with a smaller wecht, takes up the good grain as it slides down at the end, and divides the wechtful between the other two women who stand with a riddle each in her hand at the place where the new heap is to be made. The heap is made in one corner, or against any part of a wall of the barn, to take up as little room as possible. When the two women have received the grain into their riddles, they riddle it, bringing the last part of each riddling towards the edge of the heap, and casting what is left as the scum in the riddles into the bushel placed conveniently to receive it. The riddlings consist of capes, large grains, sprouted grains, small stones, the larger class of seed of weeds, that could not pass through the wire-screen in the blower, clods of earth, bits of straw too heavy to be blown away, and such like. By the time the women have riddled the quantity given them, the other woman is ready to supply them with a fresh quantity. When the corn begins to accumulate amongst the riddlers' feet, one of them takes the wooden scoop, fig. 317, and drawing with it the tail or edge of the heap into a small heap, gives it up in portions to the other riddler, who puts the remains of the riddlings into the bushel; after which the large heap is shovelled up against the wall, while the scattered grain on the floor is swept towards it with a besom, by the other riddler, or the woman who gives up the corn from the blower, as the case may be. While the unwinnowed heap is becoming less, as the riddled one increases in bulk, the woman who has charge of it shovels it up at times, and sweeps in the edge, that no scattered grains may be permitted to lie upon the floor to get crushed with her shoes. All the women should endeavour to do their respective parts in a neat and cleanly way. There is much difference in the mode of working evinced by different women in the barn, some constantly spilling grain on the floor, when they have occasion to lift it with a wecht, evincing the slattern; but it is the duty of

the steward to correct every instance of carelessness; whilst others keep the floor clean, and handle all the instruments they use with skill and neatness.

(1735.) The thrashed heap of corn being thus passed through the blower, and riddled in the manner described into another heap, the chaffy matter blown upon the floor is then carried away to the dunghill, and the light corn subjected to examination, as well as the riddlings in the bushel. When the grain is of fine quality, there will be no good grain, and little bulk in the light corn heap, which may all be put past for hen's meat; but in other circumstances the light corn, together with what is in the bushel, should again be put through the fanners, and the grain taken out of it that would not injure the clean corn, if mixed with it. When the light corn has thus been disposed of, and the seeds and dust from the screen carried out and placed on a bare piece of ground for the pigeons, fowls, or wild birds, to pick up, and *not* thrown upon the dunghill to render it foul with the seeds of wild plants, the heap should be shovelled up, the fanners thoroughly made clean and placed aside, and the floor swept.

(1736.) When corn is dressed clean, there should nothing be seen but good grains,—no shrivelled grains, no seeds of other plants, no clods of earth, no chaff, or bits of straw. It is highly probable that the amount of dressing described above will be sufficient to put the corn in a state of cleanness, but should any earth or small seeds be still detected amongst it, as the blower cannot separate these, the corn should be sifted through a sieve, a species of riddle containing very small holes, though sufficiently wide to let through such substances. Should light substances be still detected along with shrivelled grain, the whole should again be put through the fanners, and riddled as already described. Should light substances only be found, these may be blown away by the fanners, and the corn not again be riddled, but measured into the bushel, and put into sacks from the fanners. Good grain will be sufficiently dressed by one passage through the fanners, but that of inferior quality will require twice putting through; or should a superior class of fanners be used, such as to be seen below, grain of even very inferior quality may be made as clean as it can be by one winnowing. In general, oats are made clean by one winnowing, but wheat and barley require two thorough winnowings, that is, twice through the fanners, and twice riddled.

(1737.) Suppose, then, that the corn has been treated as last described, and lies in a heap to be measured into sacks, the arrangements for doing so may be seen in fig. 305, where *a* is the steward with the strike in his right hand, ready to strike the corn in the bushel *b*,

which is in the act of being filled by the two women *c c*, who are pouring a wechtful each into it at the same time, and in such quantity, as

Fig. 305.

THE MEASURING UP OF GRAIN IN THE CORN-BARN.

to fill it at once. Other two women *d d* are holding the mouth of the sack *e* ready for the bushel to be emptied into it. The first two bushelfuls are emptied into the sack from the floor, and the last two are emptied by first placing the bushel upon the half-filled sack by the steward and one of the women lifting it by its handles, and when there, the women slip the mouth of the sack under the handle nearest them, and raise the bushel a little, while the steward is turning it over from him, pouring the grain completely out of it into the elevated mouth of the sack; and thence sustaining the weight of the empty bushel with both hands, he sets it down by the handle beside the heap of corn, with one handle towards the heap and the other towards the sack, ready again to receive its contents. Four bushels, or half a quarter of grain, are put into one sack. The sack, when full, is wheeled away by the steward with the sack barrow *f* amongst the other sacks at *g*; and while the steward is doing this, one of the women *d* brings forward an empty sack from the heap *h*, which had been laid neatly down by the steward in sufficient number to contain all the corn in the heap, or what of it may be desired to be measured up at the time. As the heap *i* diminishes, one of the women *c* shovels it into smaller space with the scoop *k*, and sweeps the floor clean towards the heap with the besom *l*, and then the whole party advance nearer the heap. It is customary for the two sets of women *c c* and *d d* to take the filling of the bushel by turns every four sacks filled, as the holding of the sacks is attended with little fatigue.

(1738.) There are some particulars regarding the measuring up of grain which requires attention. In the first place, the bushel should be filled at once, because it will hold more corn when filled with two

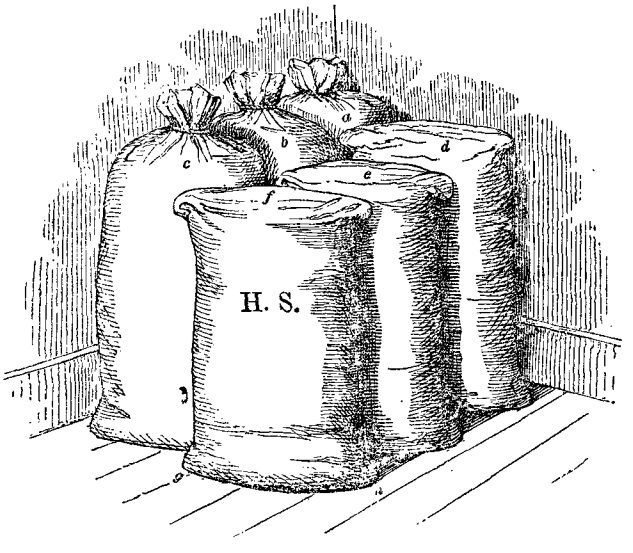
separate wechtfuls than with two at once, the first wechtful getting time to subside before the other is poured above it. In the next place, the wechtfuls should not be poured into the bushel from a great height, as the higher fall compresses more grains into the bushel. The women *c c* in fig. 305, are purposely shewn pouring the corn from too great a height into the bushel. Another consideration is, that the bushel be striked immediately after it is filled. To do it quickly, the corn raised in the centre of the bushel by the pouring should be levelled with what is called a *hand wave*, that is, a levelling turn, in the lightest manner, with the fingers of the left hand, so as to make it spread around towards the edge of the bushel farthest from the heap, and this part of the edge is sweeped with the side of the same hand, to clear it of every grain of corn, and make it ready for the strike to be applied, which should always be drawn towards the heap, in order to make the superfluous grain fall as near it as practicable. As a proof how much grain sinks in a bushel in a very short time after it has been striked, a space in the inside of the rim will be seen all the way round, the moment that the bushel is touched to be emptied; but a more obvious proof is obtained on striking the mouth of the bushel with a smart stroke of the strike, and the grain will immediately subside a considerable space. Another matter is, that the grain be well shaken down into the sack while it is measured, so as to fill up the corners, and make the whole sack firm. It is much easier for men to carry a well filled sack to a distance, and especially up several stairs to a granary, than one that is loosely put up. The filled sack can be commanded like a pack of goods; in a slack one, the grain is apt to shift its berthage, to use a nautical phrase, and of course to change the centre of gravity of the sack.

(1739.) Corn is measured up direct from the fanners in this way:—The steward drives the fans, one woman fills the hopper, another puts the winnowed grain into a large wecht, and fills the bushel at once, strikes the bushel and empties it, while the other two women hold the sacks, one of whom wheels them away with the sack-barrow as filled. There is one objection to this mode of filling up the bushel, that the tremor of the floor, occasioned by the working of the fanners, is apt to shake down the corn in it more than in the way described above. In measuring up corn for horses, or seed-corn of any kind, or the corn to be given to the men as part of their wages, it may be measured up in any circumstances; and it is only oats that can at all be measured after one winnowing.

(1740.) There remains only to make a few observations on placing sacks in a barn, tying them, and loading a cart with them for market.

To make sacks stand so as each may be taken away with ease from a number, they should be set, the first one in a corner, with its shoulder against one wall, and with the other shoulder against the other wall, as seen at *a*, fig. 306; and every other sack in the same row, as *b* and *c*, will stand with the left shoulder against the wall, and the right shoulder against the side of the sack set down before it. In the succeeding row,

Fig. 306.



FILLED SACKS AS THEY SHOULD BE PLACED IN THE BARN.

the first sack, as *d*, will have its right shoulder against the wall, and its left shoulder against the side of the first sack *a* that was set up in the corner; and the succeeding sacks, *e* and *f*, will have their left shoulders in the hollows between the sacks, *b* and *c*, in the first row, and their right shoulders against the sides of the sacks that were set down before each of them; and so on, row after row. In short, the sacks stand shoulder to shoulder, instead of side to side. Now, the utility of this arrangement is, that the sacks, in the first place, are as closely set together as they can possibly be; for the left shoulders of *d e*, as may be seen, fill up the hollows between the right shoulders of *a b* and *b c*. In the next place, as each sack is removed in the reversed order in which they were placed, it presents its broad side either to the barrow to be wheeled away, without the slightest entanglement with any other sack, or to be lifted at once as it stands upon the man's back, without the usual trouble of having to be kneed forward to a more convenient spot. Thus, look upon *f*, the last placed sack, and the first to be removed. It

is obvious that its side is presented in the most proper position for the barrow; and its corners *g* and *h* are quite ready for the hands of the persons who are to assist in raising it to a man's back. The figures shew also the difference between tight and slovenly sacking up of corn; *f* shews a slackness of putting in the first bushel into it, where there are creases between *g* and *h*, and the corners at *g* and *h* project too much out, because the corn above them is too slack. On the other hand, *d* shews a well-filled sack. When filled sacks are wheeled aside, their mouths should be folded in and closed up, as represented in the outer row *d e f*. On tying sacks, which they must be when intended to be sent away by cart, the tie should be made as near the corn as possible, to keep the whole sack firm, as seen in *a*, *b*, and *c*.

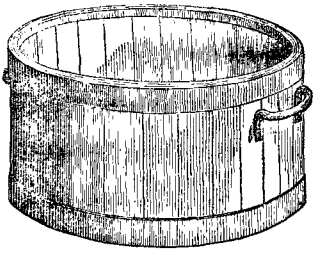
(1741.) There are three modes of lifting a sack to a man's back. One is, for the person who is to carry the load to bow down his head in front of the sack, presenting his back to its broad side, and placing his left arm behind his own back, across his loins, and his right hand upon his right knee, awaits in this position the assistance that is to be given him. Two people assist in raising it, by standing face to face, one on each side of the sack, bowing down so as to clasp hands across the sack near its bottom, as from *g* to *h*, for instance, below the carrier's head, and thrusting the fingers of the other hands into the corners *g* and *h*, which yield and go inwards, and thereby afford a firm hold. Each lifter then presses his shoulder against the edge of the sack, and with a simultaneous exertion upwards, which the carrier seconds by raising his body up, the bottom of the sack is raised uppermost, and the tied mouth downmost, on the head and back of the carrier. The lifters now leaving hold, the carrier keeps the sack steady on his back, with his left arm across its mouth. Another plan is for the carrier to lay hold of the two shoulder-tops of the sack with his arms across each other. His two assistants do as directed before; and while they lift the sack between them, the carrier quickly turns his back round to the sack and receives it there, while keeping firm hold of its shoulders, by which he retains it in its place. A third plan is for the assistants to raise the sack upon another one, and then the carrier brings his back down to the side of the sack, laying hold of the shoulders as formerly, and then rising up straight with it on his back. The last plan requires most strength from the carrier, he having to rise up; the first most from the lifters, the load being lifted high; and in the second both parties are nearly equally concerned.

(1742.) In regard to loading a cart with filled sacks, the general principle is to place all the mouths of the sacks within the body of the cart, so that should any of the tyings give way, the corn will not be

spilled upon the ground. One mode of loading a cart, a double-horse load, is represented in Plate XVIII., which is supposed to be a cart of corn on its way to a market town. Two sacks are laid on the bottom of the cart, with the mouths next the horse. Two are placed on the front, with their bottom outwards. Two are placed on the back, with their bottoms outwards, and the mouths of all the four are within the cart. These last 4 sacks are placed on their edges, with their corners just over the edge of the front and back of the cart. Other two sacks are placed above the four, and one behind, with all their mouths pointing inwards. Nine or ten old bolls, that is, 54 or 60 bushels, used to be carried by two horses, according to the distance to be travelled; but now that half-quarter sacks are in use, and the single-horse cart is more generally employed, the loads assume different forms, according to the length of the journey, and whether the horses are to be loaded or return empty from the market town. About 37 bushels of wheat, 40 of barley, and 60 of oats, making each about 1 ton weight, is considered a a good load for a double cart in the country; and a single one will take a proportionate quantity of these numbers, according to the circumstance in which the farm is situated in reference to the place where the grain is to be delivered. So that no specific direction can be given on this point. The carters in towns take much heavier loads of corn.

(1743.) The barn utensils, besides the fanners, which are particularly described below, consist of a considerable number of articles, of which perhaps the most important is the imperial *bushel*, represented in fig. 307. It is of cooper-work, made of oak and hooped with iron; and, according to the act, must be stamped by competent authority before it can be legally used; and, having been declared the standard measure of capacity in the country for dry measure, it forms the basis of all contracts dependent on measures of capacity when otherwise indefinitely expressed (5th Geo. IV., c. 74, sec. 15). The bushel must contain just 2150.42 cubic inches, though its form may vary. The form represented in the figure I consider very convenient, being somewhat broader at the base than at the top, and furnished with 2 fixed handles. It is not too broad for the mouth of an ordinary half-quarter sack, nor too deep to compress the grain too much; and its 2 handles are placed pretty high, so that it may be carried full without the risk of capsizing. Some bushels are made inconveniently broad for a sack, for the sake of being shallow, and that the corn may not be compressed in them. I have seen others spread out so much in the mouth, as to render them unsteady. Some have no handles at all, and are obliged to be lifted on the sack by the arms; whilst others have only one handle for the person who overturns the bushel to lay hold of, and that sometimes a jointed one, and there being no handle on the other side for the sack to pass under, the

Fig. 307.

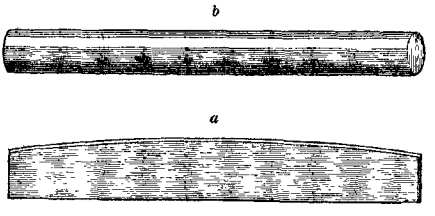


THE IMPERIAL BUSHEL OF A CONVENIENT FORM.

sack is apt to slip over the mouth of the bushel; whilst others have the handles too low to be of any service to the sack to pass under in the act of the bushel being overturned. These minutiæ become essential conveniences or inconveniences when much corn has to be measured up in a short time, and, when they are formed with a view to convenience, they contribute much to ease labour. I felt this forcibly one short day in winter, when I had to measure up 125 bolls of oats, equal to 750 bushels, with the old firlot of $1\frac{1}{2}$ bushel, of a convenient form, overturning it 500 times, and wheeling away every boll with a sack-barrow to different parts of the barn.

(1744.) In connection with the bushel is the *strike* for sweeping off the superfluous corn above the edge of the bushel. It is usually made of two forms; the one a flat piece of wood, like *a* in fig. 308; the other of the form of a roller,

Fig. 308.



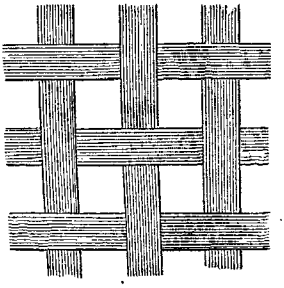
THE FLAT AND CYLINDER STRIKES.

like *b*. The Weights and Measures Act prescribes that the strike shall be of a round form, of a piece of light wood, 2 inches in diameter; but he who had put the notion into the heads of those who drew up the act, that this is the best form of strike, must have had little experience of using one. If the object is to separate one stratum of grains of corn from another, the *sharp* edge of the flat strike is evidently best fitted for the purpose. A cylinder, when passed with a uniform motion over a bushel, though not rolling, must push down some of the grain under it; and, if it is *rolled* across the bushel, it must press down still more grain, in the manner of a roller passing over friable land, and, of course, *make* the bushel hold more grain than it would naturally do. I would advise all sellers of grain to use the flat strike, whatever purchasers may wish them to do. On striking wheat, the strike is drawn straight across the bushel, the grains being nearly round, and yielding easily to the forward motion of the strike; but in the case of barley and oats, pease and beans, the strike should be moved across the bushel in a zig-zag manner, because, those grains being long or rough, a straight motion is apt to tear away some of the grains below its level. The strike should be made of wood in the best seasoned state, and of that kind which is least likely to lose its straightness of edge, while it should be light to carry in the hand, and hard to resist blows. Perhaps plane-tree may afford the nearest approach to all these properties.

(1745.) The most essential implements for separating heavy articles from corn of any kind are *riddles* and *sieves*. They are formed either entirely of wood, or partly of wood and wire. Wood-riddles have long been in use, though I believe, in the hands of a skilful riddler, the wire-riddle makes the best work. The wood is fir or willow, but American elm is the best. A riddle consists of open mesh-work forming its bottom, and of a circular rim of wood, the diameter of

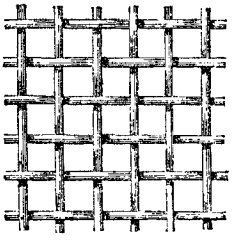
which is usually 23 or 24 inches, and its depth 3 inches. Rims are made either of fir, or oak, or beech, the last being most used. In fir rims, the wooden withes of the bottom are passed through splits, thereby endangering the splitting of the rim itself all round, which it not unfrequently does; but in the oak rim the withes are passed through bored holes which never split. The following figures of riddles are portions only of each kind, but they give the meshes at full sizes.

Fig. 309.



THE WOODEN WHEAT-RIDDLE.

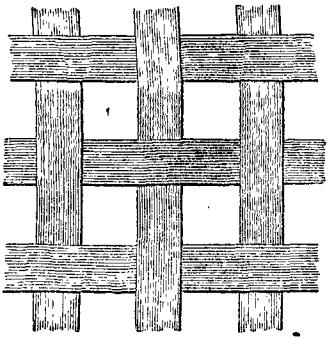
Fig. 310.



THE WIRE WHEAT-RIDDLE.

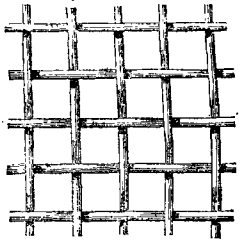
Fig. 309 is a wheat-riddle of wood, the meshes of which are $\frac{1}{4}$ inch square, the breadth of the wood-splits $\frac{5}{16}$ of an inch, and its price is 3s. 3d. with an oak rim. Fig. 310 is an iron-wire riddle for wheat, the meshes of which are 5 in the inch; and its price is 5s., with a beech rim. Fig. 311 is a wooden barley riddle, with

Fig. 311.



THE WOODEN BARLEY-RIDDLE.

Fig. 312.

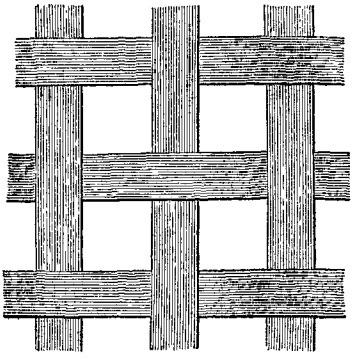


THE WIRE BARLEY-RIDDLE.

a mesh of $\frac{5}{16}$ of an inch square, the breadth of the withes being $\frac{1}{4}$ of an inch, and price 3s., with an oak rim. Fig. 312 is a wire-riddle for barley, having 4 meshes to the square inch, and price 4s. with a beech rim. Fig. 313 is a wooden riddle for oats, with $\frac{2}{8}$ of an inch square of mesh, and breadth of withe $\frac{1}{4}$ of an inch, and price 2s. 4d. with an oak rim. Fig. 314 is a wire-riddle for oats, with meshes $\frac{5}{16}$ from centre to centre, and price 3s. 6d. with a beech rim. For beans, a wooden riddle is $\frac{5}{16}$ of an inch square in the mesh, and withes $\frac{3}{16}$ of an inch in width, and price 3s. 6d. with an oak rim. A barley wire-riddle answers for beans, but, in riddling beans, a contrary result is obtained, the shrivelled beans and other refuse being riddled out, and the best grain left in the

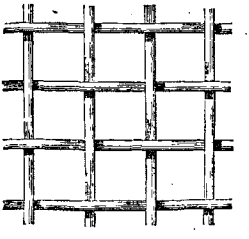
riddle. For riddling the roughs of wheat and oats a wooden riddle has meshes of 1 inch square, the breadth of the wooden being $\frac{3}{8}$ of an inch, and price 2s. each with an oak rim; and a wire-riddle for roughs is from $1\frac{3}{4}$ to $1\frac{1}{2}$ inch square each mesh, the price being 2s. 6d. with a beech rim. Riddles for roughs are called

Fig. 313.



THE WOODEN OAT-RIDDLE.

Fig. 314.



THE WIRE OAT-RIDDLE.

slap-riddles. When elevators are used in a thrashing-mill no slap-riddle is required. Sieves for riddling out dust, earth, and small seeds, when made of wood, are $\frac{1}{8}$ of an inch square in the mesh, and $\frac{1}{8}$ of an inch broad in the wood; and the price is 3s. 6d. with an oak rim. Wire-sieves have 8 meshes in the square inch, are 22 inches in diameter, are called No. 8, and are 5s. 6d. each, with a beech rim.

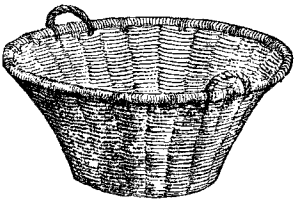
(1746.) The *riddling* of corn is a complicated and difficult operation. I never found a person that could describe it in words; and, as it is the only species of farm-labour I never could acquire to my own satisfaction, I feel that I cannot describe it to be of use to any one desirous of learning it. I may say, generally, that it consists of holding the bottom of the riddle a little inclined from you, and of giving the corn in it a circular motion always from right to left, accompanied with an upward jerk with the left hand, which seems to loosen the mass of corn, and has the effect of throwing up all the lighter impurities to the surface, while they are drawn towards the centre of the riddle into a heap; and the same jerk, at the same time, causes the heavier grain to descend quickly through the meshes. Very few people who profess to work in the barn can riddle well. I never saw a man that could do it well, but several women that could. A good criterion of the ability to riddle is this: Place a man's hat on its flat crown in the centre of a riddle, and if you can make it start upon a point of the edge of its crown, and by the motion of the riddle cause it to revolve on that point, in the centre of the riddle, as long as you please, you will certainly be able to riddle corn. The usual way is to swing the riddle from side to side, and make the corn fall through, which it easily does; but that motion sends much of the impurities along with the grain. Corn passes quickly through a *wire*-riddle; and it requires a skilful hand, with a quick circular motion, to prevent it passing too quickly. On this account, an indifferent riddler will make better work with a wooden riddle, as its withes retard the fall of the corn passing over them.

(1747.) *Sifting* is performed with the sieve, and its object is, to take out small heavy objects from corn. It is performed in the same manner as rid-

dling, but the circular motion is made to revolve much quicker. Corn is only subjected to sifting, after it has been winnowed and riddled as clean as these operations can make it; and with a thorough sifting, it is surprising what impurities may be discovered amongst it, both as a scum of light matter upon the surface, as well as heavy stuff, which descends through the small meshes, leaving the grains behind on the sieve. All seed-corn should be sifted; and I believe there is no way of doing it so effectually as with the hand. Sifting-machines have been contrived for the purpose, with more or less success, and they are now generally adopted in meal-mills, and no doubt save much manual labour, though I am doubtful they execute sifting so well as the hand; for I used to consider *meal-sifting by the hand* as the perfection of the art of riddling, as in doing it, the meal was not only moved in the same skilful way as corn when it is well riddled, but the sieve itself was, at the same time, made to revolve, in a slow jerking manner, from the right towards the left hand, thus altogether making such a complicated motion as would be difficult for machinery to imitate. Reeing-machines have been invented for cleansing corn; but with what success, compared to riddling by the hand, I cannot say.

(1748.) *Wechts* or *maunds* for taking up corn are made either of wood or of skin, attached to a rim of wood. A wooden one of fir, attached to a a rim of oak, costs 2s. 6d. A skin one, is made either of young calf's skin, with the hair on, or sheep's skin, deprived of its wool, and tacked to the rim, in a wet state, and used after the skin has become won, that is, dry and hard. Wechts should be made of different sizes; one so large as two wechtfuls shall fill the bushel with ease, and another smaller, that is, smaller of diameter, and less depth of rim, to take up the corn from the fanners, to give to the riddlers. Baskets of close and beautiful wicker-work, such as fig. 315, are used in barns in parts of England, instead of wechts.

Fig. 315.



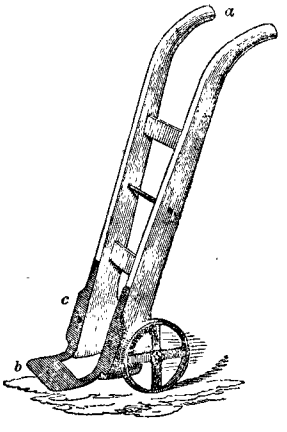
THE CORN-BASKET OF WICKER-WORK.

(1749.) The *sacks* used to contain corn, to be sent away to its destination, require to be attended to, to keep them in serviceable condition. They are usually made of a sort of canvass, called sacking, and according to the quality of the tow of which they are made, and the mode in which they are manufactured, whether tweeled or plain, their price is dependent, and which varies from 1s. 3d. to 2s. 6d. each. Every sackful of corn, before it is put into the cart, is tied at the mouth, with a piece of cord, a soft cord answering the purpose best. The ties are either attached to the seam of the sack itself, or are carried in the ploughman's pocket. Every sack should be marked with the initials of its owner's name, or with the name of the farm. The letters may either be painted on with a brush, or rubbed in through open designs of letters cut through a plate of zinc. In either case, red lead is used. The initials are put on, and appear as those on sack *f*, fig. 306. When sacks become wetted with rain, they should be shaken, and hung up in the air to dry; and if they get besmeared with mud, they should be washed and dried. If the air cannot dry them in time to prevent mouldiness, they should be dried before a fire. Where steam is used for thrashing, sacks can be dried near the boiler. The usual airy place to keep sacks, is across the granary, over ropes, suspended between the legs of the couples. Holes will break through sacks, by wear, by

tear, or by mice, which will almost invariably find their way into sacks of corn that have stood a considerable time on the barn floor. The best thread for darning sacks, is strong worsted; and if well darned, the mended parts become the strongest parts of the sack. When a considerable accident occurs to a sack, probably the best way is, instead of mending it, to keep it for cutting up to mend others. The person who has the charge of thrashing and cleaning the corn, has the charge of the sacks, and must be accountable for their number.

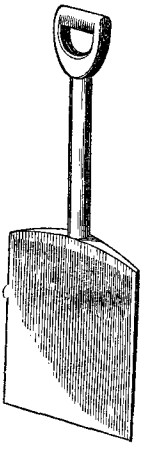
(1750.) Sacks when filled, are conveniently wheeled to any part of the barn, in a barrow made for the purpose. A good form of one may be seen in fig. 316. To be convenient, it should stand upright of itself, as seen in the

Fig. 316.



THE SACK-BARROW.

Fig. 317.



THE CORN-SCOOP.

figure. There are two modes of using it; one when the sacks stand *upright* on being filled, and the other when the sacks stand as in fig. 306. On standing behind the wheels, in the first case, and on taking a hold of the handle *a* with the right hand, the mouth of the sack, whether folded or tied, is seized by the left, and with it the sack is pushed so far off, as to admit the iron scoop *b* of the barrow to pass between the bottom of the sack and the floor; and on pulling the sack towards the barrow, and pushing the wheels forward by the right foot on the axle, the sack is placed on the scoop, and is ready for removal. In the other case, all that is required is to push the scoop of the barrow below the sack *f*, which is lying from you; and on pulling the sack towards you, it becomes ready for removal. The iron shields *c* over the wheels save them rubbing against the sacks. The height of the barrow should be $3\frac{1}{2}$ feet, and its breadth, over the wheels, $1\frac{1}{2}$ foot, and the frame made of ash, and painted.

(1751.) A couple of wooden *scoops*, such as the one represented in fig. 317, to shovel up the corn in heaps, are useful implements in a corn-barn. They are each made of one piece of plane-tree, 3 feet 3 inches in height, with a head like a common spade; a shaft 18 inches in length, and the scoop 14 inches wide and 16 inches long. The scoop, shaft, and handle, are all of the same piece, the belly of the scoop being a little hollowed out, and its back thinned away to the side and edge. This is a convenient size of scoop for women, who have most

to use it on farms. In the granaries in towns, scoops are made longer, with a handle of a separate piece, and of ash. A wooden scoop does not injure a floor so much as a spade, and it also better retains the corn upon its face, in the act of shovelling.

(1752.) A stout four-legged *stool*, 2½ feet long, 9 inches broad, and 12 inches high, made of ash, is useful in a barn, to give the women easy access to the hopper of the fanners. In lieu of this implement, the bushel is taken to stand upon.

(1753.) A *wooden hoe*, 7 inches long, and 4 inches deep in the blade, fixed to a shaft 9 inches long, made of ash, is more useful than the hands, in filling wechts with corn. *Nails* should be driven at convenient places in the walls and partitions of the barn, to hang all the riddles, wechts, and sieves upon.

(1754.) A *wall-press*, with lock and key, is necessary in a corn-barn, to hold the flask of oil, for oiling the gudgeons of the mill; the needles and thread, and shears for mending the sacks; a piece of chalk for marking the number of the sacks of corn as they are carried to the granary; and a small and safe lantern for letting the steward see to oil the various parts of the machinery.

(1755.) [*Thrashing Machine.*—I have now arrived at one of the most important machines of the farm: one on which much has been said in regard to its history, and of which, although of comparatively recent introduction, the true merit of its invention is involved in some obscurity. Like most other inventions, it appears to have come to maturity not by one mental effort, but by a succession of steps, sometimes progressive, and at other times retrograde. As may naturally be supposed, the earliest attempts at machine-thrashing, of which there is any authentic notice, were applications of the flail, a mode the most unlikely of all others to be attended with success. The county of Northumberland seems to have given birth to the first rational attempts, and that not longer ago than 70 years. The Northumberland experiments, in the hands of Mr Ilderton of Alnwick and Mr Osley of Flodden, though differing somewhat from each other,* and neither of them successful, contained the germs that led to the development of the perfect machine, not, however, without passing through other stages of probation. Amongst these transition steps is to be ranked the experiments and improvements upon the former machines by the late Sir Francis Kinloch, Bart., whose models, having been put into the hands of Mr Andrew Meikle, Houston Mill, East Lothian, served as a groundwork for that ingenious millwright, to fabricate the thrashing-machine in a comparatively perfect form;—perfect, indeed, in so far as the simple act of beating the grain from the husk was concerned. To Meikle, therefore, has been ascribed the merit of the thrashing-machine, and that he is entitled to this, as having produced the first really effective machine, there can be no question; but there can be as little, that those who pioneered the way, and brought the machine so near the mark, deserve their share of the merit. The previous machines appear to have contained the essential parts of the thrashing apparatus, the feeding rollers and the beater or scutcher; and though it is usually alleged that Meikle gained the palm by having devised the *drum* with its beaters, yet we are now well aware that a close cylinder or drum is not by any means essential to thrashing, and that the beater, when set upon open arms, and revolving at the proper velocity, will perform the work perhaps better than with a close drum. The drum, however, has taken such hold on the minds of Scotch millwrights and

* Brown on Rural Affairs, vol. i. p. 318.

farmers, that it is little less than sacrilege to propose its dismissal, though there is much probability that the day is not distant that may see the drum beaten out of the barn by the long rejected open beaters; but of this more hereafter.

(1756.) It appears that the early thrashing machine, even of those that were held perfect, did nothing more than simply beat the grain out of the husk; the remaining processes of shaking and dressing being left for manipulation. These, however, appear to have followed in rapid succession; the revolving rake-shaker having been first added, and afterwards the dressing-fan. In these early stages of the machine, the whole of it generally stood upon the ground, barns in Scotland having not then attained a *loft* or first floor. The introduction of the shaker, but more especially the fan, induced the necessity, first of elevating the mill to a greater height on the ground-floor to admit of the application of these appendages, and ultimately rendering a first-floor a necessary part of the arrangements of a well-regulated thrashing-machine. By the disposal of the parts of the machinery in two floors, the whole business is conducted in a more orderly manner, and a distinct separation of the raw material—the unthrashed corn—from the straw, the chaff, and the grain.

(1757.) *Arrangement of premises.*—The arrangement of the thrashing department of the steading with a complete machine consist, therefore, of the following parts:—1. The upper or thrashing-barn B, fig. 16, page 141, which contain the chief part of the machinery and the thrashing apparatus; here the unthrashed corn is received from the stackyard, and is delivered into the machine; and here also the separation of the grain from the husk and the straw takes place in passing through the upper works of the machine. 2. The corn-barn C, fig. 4, Plate IV., immediately below the former, and is part of the ground-floor; here the grain separated from the straw by means of the shaker and screen is received, first into the fanners, where it is separated from the chaff, and delivered at two distinct spouts, the one giving out the partially dressed grain, and called the clean spout; the other, called the seconds spout, discharging a mixture of grain with some husks and a few unthrashed ears—which is again returned through the machine. 3. The straw-barn L, fig. 4, Plate IV., into which the straw is received direct from the shakers of the machine. 4. The chaff-room *r*, situate intermediate to the two former divisions, and is usually a portion of the corn-barn, partitioned off with boarding, the fanners forming a part of the partition.

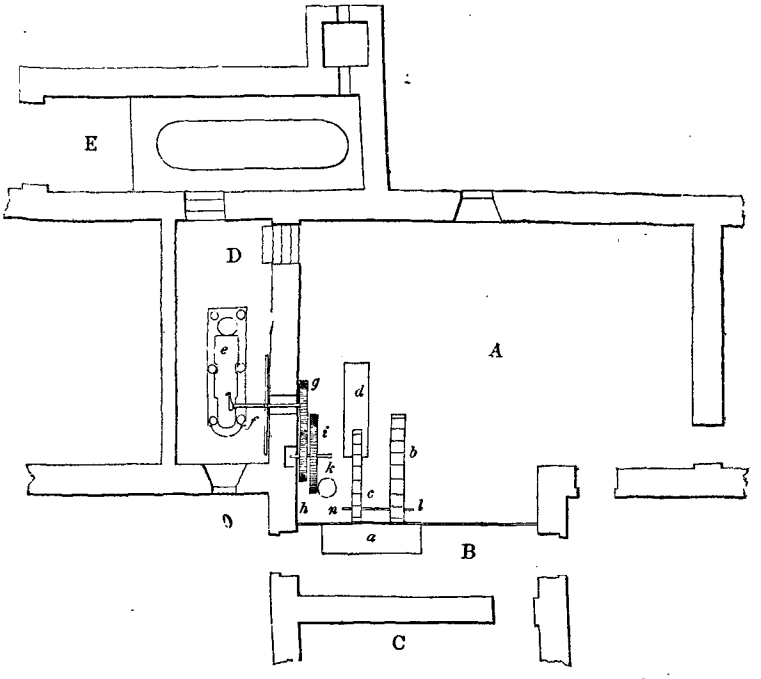
(1758.) Besides the essential divisions of the process just pointed out, there are minor divisions which are chiefly carried on in the corn-barn. These may be taken in progressive order, and are—1. The elevator from the foul or seconds spout, raising the seconds to the feeding-board. 2. The elevator from the clean-spout, raising the grain from that spout of the first fanners to the hopper of the second fanners, and in some cases a third set of elevators, lifting the grain from the second to a third fanner. 3. The hummeler, chiefly used for rubbing off the base of the awn in barley, but occasionally applied also to the other grains for specific objects.

(1759.) The arrangements glanced at in the two preceding paragraphs are subject to considerable variety, arising from local circumstances, in the relative position of the barns, the power, and other accessories; but, of these relations, the experienced millwright will be always able to seize that arrangement of the parts of his machinery that will bring out the most beneficial results, while the inexperienced will find, in the arrangements here laid down, data founded on experience and extended observation. The grounds for the general arrangements

which are here followed, are to be found in (12.), (13.), and (14.), and I now proceed to the details of the thrashing-machine and its accompanying apparatus.

(1760.) *Arrangement of the Machinery.*—A plan of the ground-floor of the corn-barn, with portions of the adjacent apartments, is shewn in fig. 318 ; A is the

Fig. 318.



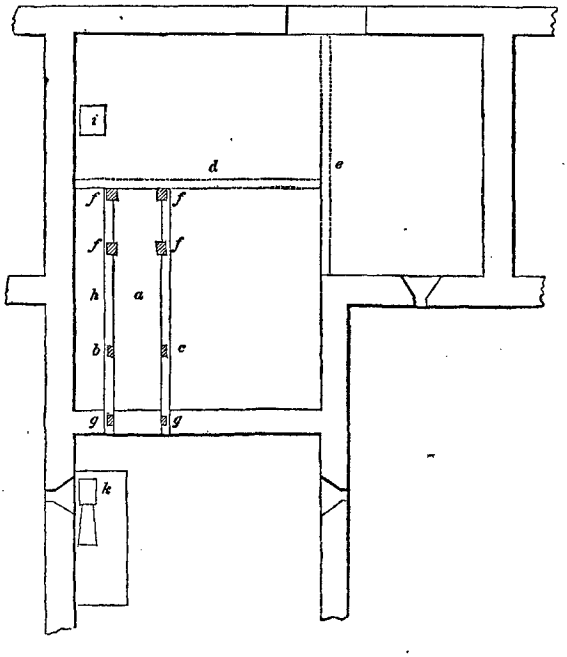
THE ARRANGEMENT OF THE GROUND-FLOOR OF THE BARNS.

corn-barn B the chaff-house, C a part of the straw-barn, D the engine, and E the boiler-house; the whole being merely an amplification of those parts in fig. 4, Plate IV. In this arrangement *a* is the position of the first fanners, *b* that of the elevator from the seconds-spout, and *c* that from the clean-spout; *d* is a position for a second fanner, supplied by the elevator *c*. In the engine-house, *e* is the position of the steam-engine, *f* the main shaft, carrying the fly-wheel, and which is put in motion by the action of the engine upon the crank. The main shaft carries also, in the usual construction, a spur-wheel *g*, but this member is subject to variation, according to the position of the engine-house and barns. In the present arrangement, and in many others, the spur-wheel *g*, as well as that marked *h*, act merely as intermedia, to bring the power into contact with the main spur-wheel *i*, the last giving motion to the drum-pinion, as will be more minutely described as we proceed. The lasting advantage of having the straw-barn placed in the most central position to the whole steading (12.), induces the one trifling addition of the intermediate wheels *g* and *h*, for the purpose of carrying the motive power from the main-shaft to the shaft of the great spur-wheel *i*, and this arises from the present arrangement not admitting of the steam-engine being advanced so far towards the straw-barn that its main-shaft might lie nearly opposite to the drum of the thrashing-machine. In cases, again, where the

corn and the straw-barns lie in one line of range—or even although their position may be at right angles, as here laid down, but their relation being such as to admit of the main shaft coming nearly opposite to the drum—the intermediate wheels become unnecessary, and the great spur-wheel *i* is then placed upon the main shaft itself. It is of small importance which of these methods of taking up the power be adopted, the additional wheels adding but a small increase to the expense, and a little to the resistance; but the lasting advantages of position may do much more than balance these. Cases frequently occur also, where only one intermediate wheel is required; and in others, it has been judged by some engineers more appropriate and expedient to dispense with all these wheels, and to substitute a large pulley in the place of the wheel *g*. In these cases, a pulley of proportionate dimensions is placed upon the drum shaft, and the motion conveyed through a belt. The only subsidiary machine that is usually placed on this floor is the humeller, at *k*.

(1761.) In the upper or thrashing-barn, and in that appropriated to the straw, the outline arrangement is represented in fig. 319, wherein, the space *a*, formed by the placement of the foundation beams *b* and *c*, is the position occupied by the thrashing apparatus. The foundation beams are, in the present case,

Fig. 319.



THE ARRANGEMENT OF THE UPPER-FLOOR OF THE BARNS.

framed into beams *d* and *e*, represented by the dotted lines; the space *a* varies in length, according to the circumstance of the arrangement of the machinery, from 12 to 16 feet, and in width, according to the power by which the machine is intended to be worked, from 3 feet to 4 feet; *ffff* mark the place of the posts

which form the frame-work of the drum, and *b c g g* those of the shakers. The space *f f h b* is appropriated to the geering or driving apparatus of the machine. Of the subordinate machines that occasionally have, but which always should have place, in this floor of the barn, I may point out the position *i*, as one very appropriate for the corn-bruiser; and, on the other hand, in the straw-barn, the position *k* is equally appropriate for the straw-cutter.

(1762.) *Details of the frame-work.*—In describing the frame-work of the thrashing-machine, it is necessary to begin with that which supports the main shaft. This, it invariably falls out, has its bearing for one point in the wall that separates the barn from the locality of the power, whatever that may be. For this purpose, when the altitude of the position of the shaft has been determined, an opening of 2 feet square is formed in the wall, as at *f* in fig. 322, Plate XX, the sill of which should be of one solid stone, laid at the proper level, and upon which the pillow-block of the shaft is bedded. If intermediate wheels are employed, another and similar opening must be formed for the bearing of the shaft of the great spur-wheel. Such other shafts, also, as may require to be extended to the wall of separation, should have bearings in recesses formed in the wall at the respective positions, such as for the extension of the shafts of the drum and of the feeding-rollers, which, in general, may be arranged in one recess, as at *i* of the same figure. The sills and bearers in these minor recesses will be found more convenient if formed of good sound Memel timber, than of stone. In further describing the frame-work, the letters of reference apply to corresponding parts of fig. 319, Plate XIX, an elevation; of fig. 321, a longitudinal section; and of fig. 322, Plate XX., a plan of the machine. In these figures, *a* marks portions of the barn-wall, *b* the ground-floor line, and *c* the foundation-beams, whose scantlings are 12 by 6 inches. The letter *d* marks the different parts of the frame-work of the case of the machine. Of these parts, the four posts which encase the drum, together with the two bearers on which it rests, are 5 inches square. The four posts, with their bearing rails, that inclose the shakers, are 5 inches in breadth and 3 inches in thickness. These timbers are joined by mortise and tenon, so as to be all *flush* on the outward side. The whole of the posts are likewise tenoned into the sill *d*, which is 3 inches in breadth and 2½ inches in depth. The four drum-posts, being of greater breadth than the sill, are tenoned with a cheek at bottom of 2 inches in thickness, which passes down upon the inside of the beams, and is secured thereto by bolts, thus giving greater stability to the drum-framing. The top-rail *d* is also 3 inches in breadth by 2½ inches in depth, and is tenoned upon the head of the posts. The top-rails of the drum-casing are joined in like manner to their posts; but their dimensions are 5 inches by 3 inches. The position and form of the feeding-board is marked by the letter *e*; and as this appendage is not required of great strength, it is usually of a temporary construction, and sometimes even portable. The two sides of the frame-work thus described require to be tied by means of cross rails, which are most conveniently fixed upon the top-rails of the framework by bolting.

(1763.) The openings in the two sides of the framing, formed as above described, are now to be filled in with pannels of ⅝ inch boarding, neatly fitted and strengthened with cross-bars at each end of the pannels. Those pannels that fill up the frame on the geering side of the machine may be permanently fixed in their respective places; but all those on the other side must be made easily movable, for giving access to the different parts of the interior for the purpose of cleaning. In the pannels that close up the drum-case, it has been

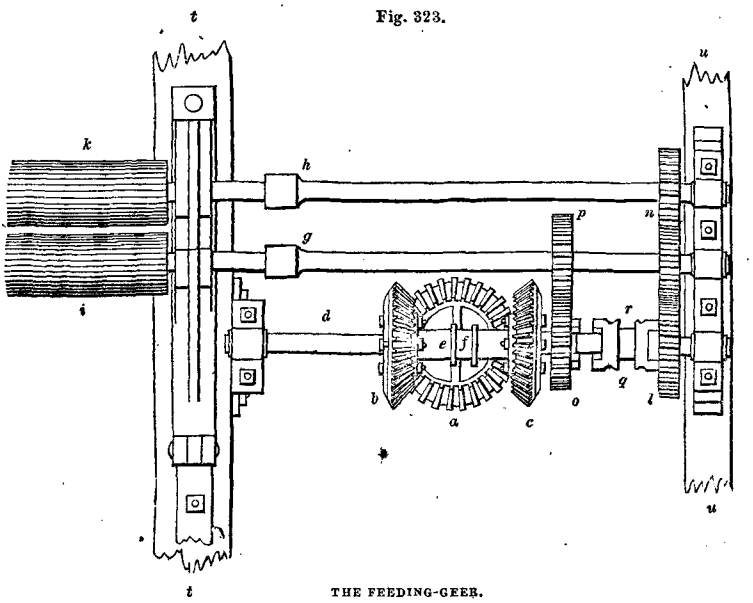
recommended to leave an opening of 6 inches diameter round the shaft, for the purpose of admitting a current of air, which, it is supposed, might prevent the winding of straw round the shaft and ends of the drum. When the construction is good in other respects, it does not appear that this precaution is necessary; but the simplicity of the proposed remedy recommends it to attention.

(1764.) *Geering of the thrashing-machine.*—I have already pointed out (1760.) the intermediate geering that is, in some cases, required between the power and the great spur-wheel. These are again represented by the dotted circles in fig. 320, Plate XIX, where *n* is the wheel attached to the engine-shaft, and *m* that upon the shaft of the great spur-wheel. These, together with the latter, may be considered as common to all thrashing-machines, except those driven by a belt; but there are two principal modes of constructing all the inferior geering, the one by means of toothed wheels, the other by pitch-chains and wheels adapted to the chains. The figures referred to in (1762.), being those in which the toothed-wheel system is adopted, I shall first advert to these again (figs. 319, Plate XIX., and 321, 322, Plate XX.), where the same letters still apply to each. The great spur-wheel, then, is marked *f*; upon its shaft is also placed one of the mitre-wheels *g'*; its fellow is mounted on the oblique shaft *g*, which gives motion to the feeding-rollers through the intervention of the triad of mitre-wheels *h*. Of these two sets of wheels, the lower *g'* may be from 12 to 15 inches in diameter, with a pitch of $1\frac{1}{4}$ inch and a breadth of $2\frac{1}{2}$ inches. The upper, or triad *h*, are about 7 or 8 inches diameter, with a pitch of 1 inch and a breadth of $1\frac{1}{2}$ inch. These, acting upon a train of small geering, produce the requisite changes of the feeding-rollers, which will be better explained by a separate figure. But it being kept in view, that the oblique shaft *g* should make either from 45 to 50, or from 65 to 70 rotations per minute; and to effect this, if the great spur-wheel make any number intermediate to these, the velocity of the shaft *g* is brought up or down, as opinion and circumstances may advise, by using bevelled wheels of different diameters, suited to bring out the required velocity, instead of the mitre-wheels *g'*. In the case now before us, the spur-wheel *f* is understood to make 50 revolutions per minute, and is therefore adapted through the mitre-wheels *g'*, for the lowest rate of the feeding-rollers.

(1765.) *Feeding-geer.*—Fig. 323 is an elevation of the feeding-geer; in which *t t* is a part of the drum-framing, and *u u* a bolster attached to the wall; and though subject to great variety, the arrangement represents a simple and completely efficient train of geering. *a* is the driving mitre-wheel of the triad *h* in fig. 322, Plate XX.; *b* and *c* are the two other wheels, these last being mounted on the shaft *d*. The wheels *b* and *c* are connected together by a tube *e*; and this combination is fitted to *slide* upon the shaft *d*, but is prevented from turning round upon it by means of a feather or rib inserted in the shaft, the tube being also grooved to receive the rib. The tube is further provided with an annular groove *f*, formed by two raised collars. The groove *f* admits of a forked lever, by which the combined wheels *b* and *c* can be moved from right to left, or from left to right. The tube *e* is of such a length, that admits of both wheels *b c* being placed out of geer with *a*; and, of course, when slid to the right, *b* comes into action with *a*, which turns the shaft *d* in one direction; but if slid to the left, *b* is disengaged, and *c* is brought into contact with the wheel *a*, and the shaft *d* is then turned in the opposite direction, while *a* continues to move always in one direction. The object of these counter-motions is to enable the *feeder* to reverse the motion of the feeding-rollers when, on any occasion, it is found necessary to make them disgorge. The object of the remaining wheels of the train

is to change the velocity of the feeding-rollers, and is accomplished by the following combination. The shaft *d*, having a velocity already given to it of 50 turns per minute, which is suited to the lower velocity of the rollers, it is only necessary to communicate that to the rollers as one of their two rates. The

Fig. 323.



THE FEEDING-GEER.

shafts *g* and *h* are respectively the prolongation of the lower and upper feeding-rollers *i* and *k*, connected thereto by the universal joints *g* and *h*, and each of the shafts *g*, *h*, are furnished with the equal spur-wheels *m*, *n*, each of 12 teeth, working continuously into each other; while *l*, of 16 teeth, is fitted to run loose upon its own shaft. The wheels *o* and *p* have each 14 teeth, *o* being also fitted to run loose on the shaft *d*, and *p* fixed dead upon the shaft *g*; the two pairs, therefore, *l m* and *o p*, are always in geer. The slide-clutch *q*, with a slide-rib, being now placed on the shaft *d*, between the wheels *l* and *o*, which, as well as the slide, are furnished with clutch-forks, and so disposed that the slide can be clutched to either of the wheels *l* or *o*, or it may stand free of both; and being always carried round with the shaft by means of the rib, and movable at all times, right or left, by a lever acting in its annular groove *q r*, the man whose duty it is to feed can at pleasure stop all motion of the rollers, by placing the lever of the slide in a middle notch, give the rollers the highest velocity by clutching the slide into the wheel *l*, or their lowest velocity by disengaging it from *l* and clutching the wheel *o*; the former being effected through the wheels *l*, *m*, *n*, the latter through *o p*, *m n*. In either of these cases, the disengaged wheel continues to be driven free of the shaft, by their respective companions *m* and *p*. The action of the slide-levers, by which the mitre-wheels *b* and *c*, and the spur-wheels *l* and *o*, are moved, will be more distinctly understood by turning to *h*, in fig. 322, Plate XX., where the apparatus just described is seen in plan.

(1766.) When it happens that the great spur-wheel has a velocity that suits the highest velocity of the feeding-rollers, and that the wheels *g'*, fig. 322, are still mitres, the train of small spur-wheels is somewhat changed. The wheels *l*, *m*

fig. 323, change places, and are, besides, moved their own breadth towards *o p*; *o p* are likewise shifted to admit the slide, but do not change places. A sixth wheel of the same number, as *n*, is then fixed on the shaft *g*, acting constantly in *n*. When the slide is now clutched into *o*, the highest velocity is produced; and when into *l*, the lowest is given out.

(1767.) When, again, it happens that the great spur-wheel has a velocity not agreeing with either the highest or the lowest velocity of the feeding-rollers, and the mitre-wheels *g'*, fig. 322, Plate XX., still retained, the arrangement is again somewhat different. In this case, the wheels *m* and *n*, fig. 323, remain upon their respective shafts, but are shifted their own breadth to one side. Suppose the velocity of the spur-wheel, and that of the oblique shaft and its wheel *a*, to be 60 revolutions per minute, the wheels *l*, *m* must take the inverse proportion of 60 to 65, or say 70, for the high velocity; and the wheels *o*, *p*, instead of being equal, take the inverse proportion of 70 to 60 for the lower velocity. It were endless to multiply examples; it is sufficient to shew the general mode of procedure, as every change of circumstance requires a new calculation.

(1768.) The arrangement of the feeding-geer has undergone many changes. Some of the older methods were sufficiently inconvenient and unscientific; but improvement has gradually made progress, and, though the varieties are numerous, they may be considered generally as efficient. The arrangement here detailed seems to possess every appliance that the case requires; it can be instantaneously adjusted while the machine is in motion, and yet it is free of complication and of liability to derangement. The couplings of the shafts I have called universal joints, but they hardly claim that appellation; nor, in the case of the lower one *g*, is that principle required; in the upper shaft *h*, the principle of universality of motion, is, however, necessary, to accommodate the rising and falling of the upper roller with the quantity of feed, while the end *n* of the shaft lies in a permanent bearing. This coupling, as usually formed, is simply a box or socket formed on the end *h* of the shaft, and in its cross section the box is usually oblong, being 1½ inch by 1 inch, or a little more, while the corresponding end of the roller-shaft is formed to fit so loosely into this socket as will allow the shaft *n h* to rise to an angle of 10° with the horizontal line, and this it must be capable of doing in any part of its revolution. This mode of coupling being so simple, is also applied to the shaft *g*, though, having no change of direction to encounter, the yielding joint is not essentially necessary. The shafting of this geering is usually 1¼ inch in diameter.

(1769.) *Geering of the Drum.*—The drum, as the principal member of the machine, requires the most direct means of communicating the power to it; hence the pinion of the drum is usually driven directly by the spur-wheel; but it is also necessary, with the high velocity at this point, to produce a smooth action, and the difficulty and expense of procuring this, when rough cast-iron is employed, is such, as to have induced the practice of employing cogged wheels, now in most cases adopted. By the term cogged wheel is now understood any wheel, the eye, arms, and rim of which are of cast-iron, but having the teeth formed of hardwood, generally beech, set firmly in mortises previously cast in the rim; hence such wheels, in the language of the mechanic, are frequently called *mortise* wheels. The great spur-wheel *f*, then, figs. 319, Plate XIX., and 322, Plate XX., is a cogged wheel of 5½ feet diameter, having 120 teeth, the pitch of the teeth being 1¾ inches, and the breadth 4 inches. This drives the pinion *i*, which is placed upon a prolongation of the drum-shaft, the prolonged part being coupled to the true shaft immediately outside the frame-work, as seen in the

fig. 322 between *d* and *q*, though some makers prefer the whole being in one piece. The pinion *i* of the drum is here 12½ inches diameter, with 22 teeth; and, as ought always to be done in the case of a pinion being driven by a cogged wheel, the pinion is turned true upon its own shaft, the cast teeth correctly graduated afresh, the correct curve drawn upon them, and the whole dressed off to equality by the chisel and file. For this purpose, pinions that are to be *dressed true* must be cast with their teeth of such extra thickness as will admit of this dressing, and still possess the due thickness and strength required for true action.

(1770.) *Geering of the Shakers.*—The shakers being required to move at a velocity considerably lower than the drum, and even lower in general than the great spur-wheel, a reduction of velocity becomes necessary. In the arrangement under consideration, this is effected by extending the main shaft *f'*, fig. 322, Plate XX., by means of a coupling piece extending to, and resting on, the beam *c*. This extended part of the shaft carries the small wheel seen at *k* in the same figure, but is hid in fig. 319, Plate XIX., by the eye of the great spur-wheel. This small wheel is 10 inches diameter, and acts upon the intermediate wheel *k*, which is not furnished with a shaft, but turns upon a strong fixed stud. The wheel *k* acts upon *l*, which is fixed upon the shaft of the first shaker *l* of fig. 321, Plate XX. The continued train of spur-wheels *l m*, *m n*, together with *k*, are all of one size, 2 feet diameter, 1⅛ inch pitch, and 2 inches broad. Of these *m*, *m* are also intermediate, or applied to convey motion from *l* to *n*; the latter, *n*, being fixed upon the shaft of the second shaker, while *m*, *m* turn upon studs like *k*. These studs are inserted into a swing-bar that can be bolted to the horizontal rails of the framing, in such position as will bring the intermediate wheels into proper pitch with the principals *l* and *n*.

(1771.) *Geering of the Fanners.*—The motion for the fanners is taken with great convenience from the drum-shaft, on the extension of which is placed a grooved pulley of 9 inches diameter, at *q*, fig. 322, Plate XX.; a corresponding pulley *s*, fig. 319, Plate XIX., is placed upon an extension of the fan-shaft of the fanners, the extended part being coupled to the principal shaft of the fan immediately adjoining to the pulley, and the extreme end supported in a bearing on the post *t*. The driving-pulley *q* being 9 inches diameter, and making about 360 revolutions per minute, the pulley *s*, in order to bring the fan to a proper velocity of 220 revolutions per minute, requires to be made about 14½ inches diameter. Since these two pulleys stand at right-angles to each other, and the rope-band (usually employed) cannot, for that reason, apply directly to them, it requires to be carried in the direction *q r q s*, fig. 319, Plate XIX., *r* being a slide-frame in which two leading pulleys, mounted in a case, are fitted to slide in the vertical direction, thus serving at the same time to lead the band in the proper direction to the pulleys *q* and *s*, and to tighten or slacken the band. The pulley-case is moved in the slide, either by a long screw or by a tail-rope, which, when the case is adjusted, is fastened to a cleat. The second fanners *a'*, fig. 319, are most conveniently driven by a band of rope or leather *c' c'*, from a pulley set upon the extreme end of the drum-shaft; but this, in all the figures, is hid from view by the adjacent parts. The band passes down through the floor, and directly under the corresponding pulley on the fan-shaft. The pulleys for this purpose are of the same diameter as those described for the first fanners.

(1772.) *Geering of the Elevators.*—The methods of giving motion to the elevators are numerous, depending frequently on the arrangement of the machinery, and sometimes on that of the barn. The one here adopted is, by placing a

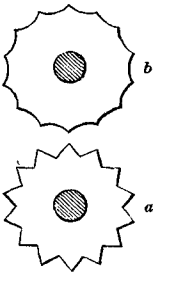
chain-wheel on the great spur-wheel shaft immediately behind the mitre-wheels *g'*, fig. 322, Plate XX. A corresponding wheel *v* is placed on a shaft appended to the lower side of the foundation beams by plummer-blocks, and reaching across both beams. Over these wheels the pitch-chain *u u*, fig. 319, Plate XIX., is applied, which gives motion to *v*. On the shaft of the wheel *v*, and at a point directly in front of the clean spout of the fanners *p*, are placed two plain wheels or pulleys, of about 14 inches diameter; these carry the belts of the elevator *w w*, which, by descending to the lower pulleys, becomes the driver of the elevator *y y*, the lower pulleys of both being on one shaft. This arrangement will be better understood by turning to fig. 318, where *l n* is the shaft lying under the floor of the barn; *c* being the clean elevator, and *b* the foul, the pulleys *x*, fig. 319, Plate XIX., are placed on this shaft at *n* (fig. 318), to suit the clean spout, and a second pair at *l*, to suit the foul spout. Corresponding to this last pair of pulleys, there is also placed in the upper-barn, at a sufficient height above the feeding-board, another pair of pulleys, one of which, *y*, is seen at the upper extremity of the elevator *y y*, fig. 319, Plate XIX., and placed on a shaft appended by plummer-blocks to the collar-joists of the roof. Thus arranged, the chain *u u* gives motion to the elevator *w*, which, in its turn, through the medium of the lower pulleys *x* and their shaft, gives motion to the elevator *y*.

(1773.) In cases where elevators for the foul spout only are employed, the chain *u u*, fig. 319, Plate XIX., is carried to a chain-wheel placed on the shaft of the pulleys of the upper extremity of the elevator *y*, or, if circumstances render it more convenient, to the lower extremity *x*; and in either case, it is obvious that the elevator *w*, instead of being the driver, may be made that which is driven.

(1774.) Having considered the construction of the frame-work, and the application of the geering of the thrashing-machine, I proceed to notice the construction and action of the active parts of the machine, and their relation to each other.

(1775.) *Of the Feeding-rollers.*—The feeding-rollers have had their varieties of change, and these varieties have arisen from attempts to overcome an accident to which feeding-rollers are liable when thrashing corn in a damp state,—the winding of straw around them. To obviate this, rollers have been made, both plain, and both fluted in various forms; they have been made of hard-wood, and wrapt spirally round with hoop-iron; have been turned truly round in cast-iron, and fitted up with scrapers constantly acting upon them, to prevent adhesion of the straw; and with one fluted, and one plain, without being turned true. The forms now most generally adopted in Scotland, is represented in fig. 324, where *a* is a transverse section of the lower roller, fluted in an angular form; while the upper roller has its transverse section, *b*, forming a polygon, whose sides are slightly concave. In both, the breadth of the flutings and of the faces are from ¾ to ⅞ inch. In the Scotch thrashing-machine the rollers are invariably made of cast-iron, with journals or gudgeons of malleable iron, either cast into the roller, or afterwards fixed in with wedges. Their diameter is usually 4 inches; and for their length, it is always desirable that it be 1 or 2 inches greater than that of the drum. The weight of a roller, therefore, of 3½ feet in length, will be about 140 lb. The velocity of revolution of the

Fig. 324.



TRANSVERSE SECTIONS OF THE FEEDING-ROLLERS.

feeding-rollers is a point of great importance in this species of thrashing-machine, and is affected by various causes, such as the length of straw in the wheat compared with that of the barley and oat crops. The state of the crop also requires to be considered as to its dryness and dampness, with other causes arising from soil, climate, &c. Independent of these considerations, if the rate of feeding be too slow for the velocity of the drum, the work will be slowly performed, and the straw will be much broken. If, on the other hand, it be too fast for the drum, the corn will pass through imperfectly thrashed; both of which results it is desirable to avoid. The results of the experience for many years of numerous mill-wrights, have determined a mean range of velocities which appear best suited to obviate the greatest number of difficulties. These velocities, when stated in terms of that of the drum, are, that the rollers of 4 inches diameter make one revolution to five of the drum as the maximum velocity, and one to six and one-third as the minimum. When compared by the spaces over which the straw is passed in a given time between the rollers, the maximum rate is 73 feet, and the minimum 57 feet, per minute. Or, taking the number of strokes of the beaters in a given length of straw, we have, in round numbers, twenty-four strokes on one foot of length of straw as the maximum, and, for the minimum, nineteen. Some makers, it may be remarked, make the maximum higher, and the minimum lower, than the above rates; but unless a third or mean velocity, could be obtained, which no doubt could be done, there seems to be no advantage gained, from pushing the extremes—the maximum and minimum rates—beyond reasonable limits.

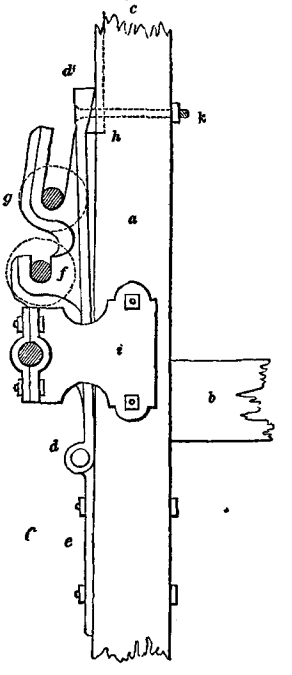
(1776.) The rollers are usually placed in front of the posts of the drum framing, and the lower one at a height of from 3 to 5 inches above the level of the drum's centre, the lower I hold to be the better of the two; the upper roller, of course, lies upon the lower when not in action, with straw between them. They are supported in brackets of various forms; and as it is necessary that means be afforded to vary the distance of the rollers from the beaters, numerous methods have been taken to accomplish this, by varying the form and means of applying these brackets or bolsters.

(1777.) I have, in the course of my practice, applied a very perfect and easily managed form of bracket, but which is, perhaps, too expensive for the remuneration afforded from the making of thrashing-machines. The principle of the method is:—The two brackets are fitted to move horizontally in a metal slide; and their movement is effected by a screw passing into each. Each of the screws is mounted with a small mitre-wheel, serving as the head by which it is turned. A slender shaft extends from the one bracket to the other, and carries two more mitre-wheels, which act upon the two former. A handle is fitted to the slender shaft, and, by turning this either way, the screws are acted upon through the mitre-wheels, and ultimately on the brackets, to move them backward or forward simultaneously, and with the greatest precision.

(1778.) A simpler and very efficient method has also been adopted, which is represented in fig. 329, where *a* is a front post of the drum framing, *b* a part of the bearer of the drum, and *c* the place occupied by the top-rail; *d d'* is the bracket, *e* is a tail, hinge-jointed at *d*, and is bolted dead upon the post; *f* is the bearing of the lower roller, and *g* that of the upper, which is formed as a curved slit concentric to the circle of the drum. At the top *d'* of the bracket, and on the back part, a wedge-form piece is cast upon it, forming an inclined plane. The reverse wedge *h* is of malleable iron, forked or slit from the head towards the

tail, to pass over the bolt *k*, and terminates in a screw and nut; the tail is sunk into the post, and passes upward through the top-rail, where it is held in the position required, by the screw nut. It is obvious, that by drawing the wedge *h* upward, it will press the head of the bracket outward; and the nut of the bolt *k* being then screwed tight, the bracket will be held fast and secure. A separate bracket *i* is bolted upon the post *a* serving as a bearing for the shaft *d*, of fig. 323.

Fig. 329.



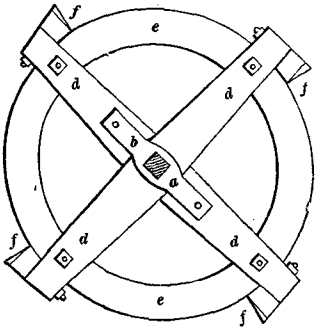
THE BRACKET OF THE FEEDING ROLLERS.

(1779.) *Of the Drum.*—The construction and properties of the drum, as it is the prime member of the machine, require the most careful consideration. In the Scotch practice, it is invariably made a close cylinder; but the propriety of this will be considered in another place. Proceed we, in the meantime, to consider its construction agreeably to that practice. The shaft, always made of malleable iron, is usually $1\frac{3}{4}$ inches square, sometimes 2 inches, and rarely $1\frac{1}{2}$ inches. Upon this is mounted generally two sets of crosses or arms of hardwood. The quality of lightness, especially towards the central parts, with a due degree of strength, being of great importance, these arms should be of the best and toughest materials. Their dimensions at the centre need not exceed 4 inches by $2\frac{1}{2}$ inches, tapering to $2\frac{1}{2}$ inches square at the ends. They are half-lapped in pairs at the centre, and strengthened by a plate of malleable iron on each side, with a bolt on each arm, passing through the plates and arms. By means of these plates, also, they are firmly wedged upon the shaft, one set of arms being placed at each end. Fig. 330 is a transverse section of the drum thus constructed, shewing the shaft *a*, the plates *b*, and the arms *d*. To these are added, upon each set of arms, a ring of hard-wood *e*, worked in segments, and bolted to the arms. This ring, $2\frac{1}{2}$ by $1\frac{1}{2}$ inches, and 28 inches of external diameter, besides binding the extremity of the arms, serves as a bed for the covering, which is now always made of sheet-iron of the strength of $1\frac{1}{2}$ lb. per superficial foot. The portion of the arms that projects beyond the ring serves as the bearing to which the beaters *f* (seen here also in transverse section) are bolted; these are $3\frac{1}{2}$ inches in depth, and 2 inches in thickness. The striking face of the beaters is formed to lie in the radii of the circle, and is faced with an iron-plate from end to end, the breadth of which may be from 2 to $1\frac{1}{2}$ inches, usually steeled on the striking edge with a thickness of $\frac{3}{8}$ inch, and securely fixed with bolts or screws. The ends of the drum are covered with $\frac{3}{4}$ inch boarding, and dressed off truly by turning.

(1780.) Such is the construction of the drum most frequently adopted, but other methods are also followed. In some cases, arms of cast-iron instead of wood are employed, and these, if judiciously proportioned, are, in some respects, superior to wood,—all the other parts outward remaining as described above. A third method has also been adopted, wherein the arms and ring are in one piece

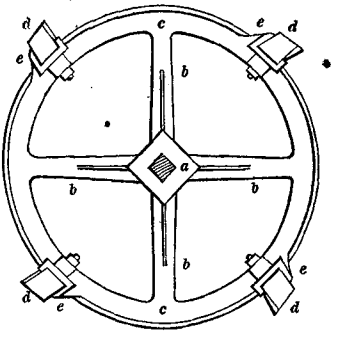
of cast-iron, comparatively light. Fig. 331 represents this mode of construction in transverse section as before, where *a* is the shaft, *b* the arms, 2 inches by ½ inch, and *c* the ring, having the same dimensions; its diameter over all

Fig. 330.



TRANSVERSE SECTION OF THE DRUM.

Fig. 331.



TRANSVERSE SECTION OF THE DRUM.

being 2 feet 6 inches. In this the beaters *d* are only 3 inches in depth; they are bedded upon a flange projecting on each side of the ring, and bolted in that direction, but supported, besides, by the lip *e*, which rises and supports them behind in the direction of the stroke.

(1781.) The position of the drum in relation to the feeding-rollers has been already stated (1776.); its distance from them ranges from ½ to ¾ inch, the mean of these being the distance most generally acted upon. The height of the drum's centre above the floor of the barn varies, with local circumstances, from 1 to 2 feet, there being no special rule to confine it to any precise height between these limits.

(1782.) The diameter and length of the drum has undergone many changes. In the early period of its history, it appears to have been of moderate dimensions, but with the extension of the use of the machine came an impression that its parts should be also extended; and, accordingly, about 30 years ago we find the length of the drum extended to 5 and even to 6 feet, and its diameter to 3½ feet. These, no doubt, are extreme cases. But the general opinion then was, that a large drum was the only means by which a large quantity of work could be performed. During the last 20 years, opinions have taken the contrary direction, and the drum has returned to more reasonable dimensions. This last change has, no doubt, been in part brought about by the introduction of steam as a thrashing power, for by it a machine that with 6 horses could, with an effort, thrash 30 bushels of wheat per hour, will now, with a 6-horse power engine, thrash with ease 45 bushels in the same time, and that with a drum not exceeding 3½ feet in length and 3 feet diameter,—there is now, therefore, a general disposition to approach these dimensions as a standard. With such power it has been found that one man can feed for the thrashing of 45 bushels per hour, or even as high as 60 on an emergency; but, even with the latter quantity, and though the drum were 5 feet long, the spread of the corn does not extend beyond 3½ feet of its length, or more properly to only 3 feet of it; hence all that is over the greatest of these is superfluous length, and ought to be removed. Since a machine with a drum of

3½ feet is capable of thrashing 450 bushels in 10 hours, the whole produce of a farm of 500 acres could be thrashed in from 30 to 40 days, which seems abundantly expeditious; and, therefore, the maximum length of drum may be fairly taken at 3½ feet for a six-horse power engine; and, by the same calculation, 3 feet for a four-horse power, and 2½ feet for a two-horse machine, the diameter of the drum in all cases remaining the same,—3 feet. Under the system that admitted of large drums, the number of revolutions was necessarily low, and during these periods it was generally limited to 300 per minute, which, with the diameter of drum then used, gave an annular velocity, at the extremity of the beaters, of about 3300 feet per minute. With the changes related above, the number of revolutions has been increased, while the diameter has decreased. The medium rate now employed is 350 revolutions per minute, but frequently 400; with the former number, the velocity of the beaters continues nearly the same as when the large drum was employed; but with a rate of 400, the velocity amounts to 3300 feet per minute. There is good reason for concluding that a mean velocity of 3500 feet per minute will yield the maximum effect under the system of thrashing herein described.

(1783.) In the Scotch thrashing machine the action of the beaters is upward, and this, with very few exceptions, is invariable. From the construction of the thrashing parts of the machine, the corn is kept under the action of the beaters for a very short space; for, however well the feeding-rollers may hold on the straw, the ear passes beyond the reach of the beaters, when it has passed over about one-fourth part of the circumference of the drum-case. This I hold to be a defect in the machine, and that to this defect may be ascribed almost all those complaints of imperfect thrashing, not unusually ascribed to defects in the shaking department. In another class of thrashing-machines, which I shall take occasion to notice shortly, this defect is obviated by retaining the straw under the action of the beaters during its passage over at least two-thirds the circumference of the drum-case; and there appears every reason to conclude that the thrashing process of the Scotch machine would be much improved by adopting a similar arrangement, and which could be easily effected.

(1784.) *The drum-cover.*—The thrashing process is accomplished by subjecting the corn and straw to the action of the beaters, while it is held by the feeding-rollers. But in order to give full effect to the blows of the beaters, the straw is resisted and held to the action by means of the apron or cover of the drum. The cover is a strong concave board *i*″, fig. 321, Plate XX., equal in length to the drum, and in breadth measures about 27 inches. The boarding is 1 inch in thickness, and is fastened by nailing it upon three segmental bars, placed outside, of hard wood or of cast iron, the concave surface being also lined with sheet iron. The radius of curvature of the interior surface is 3 inches greater than that of the drum itself; and it is suspended at its upper edge by a swing link, capable of being shortened or lengthened at pleasure by a screw. The average distance of the upper edge of the concavity from the beaters is about 3 inches, while the lower edge coincides with a circle that would touch the feeding-rollers, or about ⅝ inch distant from the beaters. Different methods are followed in forming the junction of the feeding-rollers with the apron. In some cases, the front edge of the apron is cut off nearly vertical, so as to allow the upper feeding-roller to pass the apron when raised up by the feed. In this case, the lower edge of the apron forms an acute angle, and is supported in a swing link similar to that of the upper edge. Another method is to rest the lower

edge of the apron on the journals of the upper roller by means of a gland at each end, bolted to the lower edge of the apron, and having a bearing on the journals. In this case, the lower edge of the apron is worked off to the curvature of the roller to a small extent, and keeps always close upon but not touching it. By these means, the lower edge of the apron rises and falls with the roller; and when so rising and falling, it swings upon the upper link, and the roller has consequently the weight of the apron always upon it. When the straw has passed the apron, it is prevented from flying off by a plain board, placed in a tangent to the curve of the apron, as in the figure, which leads it directly from the apron to the shakers.

(1785.) The casing of the drum is completed by having an arc *k*, fig. 321, Plate XX., formed underneath, extending from the rollers at *h'* to the breast of the casing at the top of the inclined plane *l''*; its position and curvature being such as just to allow the beaters to revolve freely. This part of the casing is formed of 1-inch boarding laid upon three segmental ribs of hard-wood *k*.

(1786.) In the operation of the drum, it is occasionally, from the state of the straw, subject to an inconvenience arising from an accumulation of straw between the ends of the drum and the casing boards. This seems to occur only where an unnecessary wide space is left between the ends of the drum and the boarding. With due care, this space may be reduced to $\frac{1}{8}$ inch, but should never exceed $\frac{1}{4}$ inch; and by attention to this on the part of the maker, all inconvenience from this cause may be avoided. See also (1763.).

(1787.) *Of the Shakers.*—Next in importance to the drum stands the shaking apparatus, for separating the loose grain from the straw. That mode which is of the longest standing, and by far the most generally approved of, are the *rake* shakers, *l* and *n*, figs. 321 and 322, Plate XX. They are variously formed, having sometimes a close cylindrical body like the drum, with rake-heads projecting from it, as in *n*. It is also formed with a square and with a pentagonal body, the rake projecting as before; and lastly, a square form, with concave sides, which, uniting at the angles, shoot out into the rake-heads, as in *l*, which is a form that has been well established for a first shaker, the concave spaces affording good range for the reception of the grain and straw from the drum. In the construction of this shaker, two very light frames of cast-iron, of the form represented in the figure, consisting of the four arms, about $1\frac{1}{2}$ by $\frac{3}{4}$ inch, and the four concave sides, having the same scantling. These, after their junction, proceed to the distance of 27 inches from the centre, when they are turned off into the palm, which stands at an angle of 45° with the direction of the arm. The entire length of the shaker should be 4 inches, at the least, longer than the drum; and the two frames just described are set upon the shaker-shaft, at about 5 inches within the intended length. The rake-heads are $2\frac{1}{4}$ inches square, and of the full length of the shaker; they are bolted to the palms of the frame, and are bored for the insertion of the spikes or teeth, which are set on the heads at spaces of about 4 inches apart, their length being about 8 inches beyond the head. In the several heads, the same distance apart is observed for the teeth; but they are so arranged in each, that those in any one rake follow a different track from the teeth of any of the other three heads. The radius of the shaker, measuring to the extreme points of the teeth, is 3 feet; and the distance of these from the beaters is usually about 9 inches. In all cases, the grain and straw pass under this shaker, and the position given to the teeth has the effect of pressing the

straw down upon the grating while in progress over it, producing thereby a process of rubbing, to aid the discharge of the grain. But so soon as the straw is relieved from the friction of the rake, the same position of the teeth discharges it with certainty upon the second shaker.

(1788.) The second shaker *n*, figs. 321 and 322, Plate XX., has also undergone various changes; but, in general, it is either a close or a skeleton cylinder, with rakes attached. Some makers prefer sending the straw over the top of the second shaker, and there is good reason for recommending this practice. When this practice is adopted, the shaker is necessarily of the skeleton make, to allow the grain to fall through it; and the present example is upon this principle. It consists of two sets of arms, each, as seen in the figure, extending to a radius of 21 inches, when each arm terminates in a palm, standing at an angle of 22° with the direction of the arm. A ring of hard-wood, 2½ inches by 1½ inch and 3 feet 4 inches diameter, is bolted upon each set of arms, as in the figure; and they are thus set upon the shaft 5 inches within the extreme length of the shaker, as before. A series of triangular laths are then nailed upon the rings, their length forming the body of the shaker, and set at 4 inches apart. Four rakes, formed as described for the first shaker, are bolted upon the palms, which complete the structure; and the radius in this case, taken to the point of the teeth, is 2 feet 6 inches. There is sometimes a necessity for the adoption of this kind of shaker, namely, when the barn is so low that the great hopper cannot be extended under the whole length of the grating of the second shaker, without giving the hopper such a low angle, that grain, particularly barley, would lodge upon it. To obviate this, a part of what ought to be grating is boarded over, as at *n'*, fig. 321; and to prevent grain from accumulating upon this, brushes are applied over one half of two opposite rakes, in the manner shewn in figs. 321 and 322; the teeth in these parts being left out, and the brushes attached by means of adjusting screw-bolts, by which the brushes are adjusted to sweep the grain into the grating.

(1789.) It will be observed, that when the second shaker takes the straw *over*, and if driven by wheel-geering, the two intermediate wheels *m m*, fig. 319, Plate XIX., are required; but if the straw is taken *under*, then the shaker revolves in the opposite direction, and to effect this, one intermediate wheel only is required; in which case, also, the wheels, instead of being 2 feet diameter, will require to be 3 feet 2 inches, or thereby. In the case of working under, also, the rake-teeth must be placed at the angle 45°, as in the first shaker.

(1790.) The position of the shakers vertically, in relation to the drum, may, without detrimental effect, be varied according to local circumstances; but with a 6-feet first shaker, its centre should, on an average, be 9 inches above the level of the drum's centre. This will give the plane *l''*, fig. 321, leading from the drum, an inclination of about 40°, which will be sufficient to prevent any accumulation of grain or straw in that part of their course. The centre of the second shaker, of 5 feet diameter, may be placed anywhere between that of being on a level with the former to 6 inches below its level; the height of the barn being, in this respect, the principal object of consideration, in order that the spread of the great hopper may be as great as possible, which, it will be observed, is shortened by lowering the second shaker. The velocity of the shakers is the last point of importance; and on this it may be observed, that the smaller the quantity of straw in the grasp of the shaker at any one time, so much the better will the work be performed. This will be effected by giving the shakers the

highest velocity at which they will deliver the straw, without risk of carrying it round on the teeth of the rakes, and these points will be obtained by giving the shakers a velocity of from 25 to 30 revolutions per minute.

(1791.) *The Screen or Grating.*—The screen, over which the straw is carried by the action of the shakers for the final separation of the grain from the straw, extends from the breast of the drum-case, following the curve of rotation of the shakers, onward to the extremity *n'*, fig. 321, Plate XX. The part *l''* is close-boarded, and covered with sheet-iron, in the position as described (1790.). At the bottom of this inclined plane, the screen proper begins. It is formed in various ways, some makers using a cast-iron grate, with square meshes of 1½ inch on the side, the iron being $\frac{5}{16}$ inch in thickness and ½ inch in depth; others apply splits of deal, ⅝ inch thick and 1½ inch in depth, placed at intervals of 1¼ inch in width, the splits being crossed by other splits of the same breadth, but only ⅜ inch in depth, placed at intervals of 2½ inches. A third method may also be recommended as strong and durable, composed entirely of straight rods of malleable iron, ½ inch diameter, and laid at intervals of ⅝ inch. The first and the last, though the most expensive, are very efficient, and are the most durable. In all the three methods, the gratings are supported on segments of hard wood *l'' l' m''* and *m' n'*, worked off to their respective circles, and nailed to the foundation beams and framing; and when the machines are of the widest, a central segment is also applied to support the middle of the splits or rods. The portion *n'* lying beyond the great hopper is close-boarded, and a continuation of this, marked *o'*, is placed in a sloping direction, to carry the straw over the wall, and deliver it upon a sloping rack placed in the straw-barn.

(1792.) *The great Hopper.*—The dimensions of the hopper *o*, fig. 321, Plate XX., are regulated by the height of the barn and the breadth of the machine; the latter being equal to the length of the shakers, and the former adapted to the extent of the grating. The bottom of the hopper is adapted to the width of the fanners in one direction, and is usually from 20 to 22 inches in the other direction. The inclination of the ends should never be lower than an angle of 55°; the sides will always fall to have a sufficiently high angle. The entire hopper is formed of ¾-inch boarding, and its object is to collect the grain from the grating, and to deliver it into the fanners.

(1793.) *The Fanners.*—The first or machine fanners *p*, fig. 319, Plate XIX., are placed in a central position under the grating, so that the two ends may have equal slopes. The height of the fanner-case is about 5 feet, and the extreme length 8 feet. The width is a point on which great difference in practice exists, some makers being satisfied with a width of 20 inches, while others give 36 inches, the power of the machine being the same. These extremes I consider to be both in error, and that a width of 26 to 30 inches is sufficient for every purpose. Mr Docker, Findon, Banffshire, who has devoted much attention to the construction of thrashing-machines and fanners, is of opinion that fanners of great width never blow equally, and has adopted a double-headed fanner to obviate this defect, consisting of two narrow fans conjoined; air being admitted between the heads as well as on the outsides, the two blasts being combined on leaving the fans.* The details of the first fanners being so much akin to those of the second or barn fanners, I shall leave them to be treated of more at large under barn utensils.

* Prize Essays of the Highland and Agricultural Society, vol. xii. p. 416.

(1794.) *The Elevators.*—The elevators are simply a chain of buckets, sometimes attached to actual chains, but more frequently to leathern belts. The buckets of that from the foul-spout *y y*, fig. 319, Plate XIX., and fig. 321, Plate XX., are 14 inches in width, scoop-shaped, with a depth of 4 inches and a length of 10 inches. The ends *y y* are formed of hard-wood, and the back and bottom of light sheet-iron, bent round, and nailed upon the edges of the wooden ends. The buckets are now attached to the two leathern belts, 2½ inches in breadth, at distances of 2 feet from bucket to bucket, by one rivet or a small screw and nut in each end of each bucket. The two belts, with their buckets, are then laid round the pullies at top and bottom, and connected at a proper degree of tension; and to prevent any inequality of motion in the two belts, it is well to attach two diagonal straps to them of about 4 feet in length. As the lower end of the chain of buckets passes under the level of the floor, a boarded cradling is there formed to collect any stray grains that may fall beyond the buckets, where, as they accumulate, they are taken up by the buckets, in their transit through the cradle. The contents of the buckets are discharged as they turn over the upper pulleys into the shoot *z*, from which they fall upon the feeding-board *e*.

(1795.) The clean elevators *w w* are formed after the same manner, except that the buckets are of smaller size, their breadth being only 10 inches, and depth 3 inches. They are sometimes formed also on a canvass web, but the principle is the same in all. The clean elevators discharge their contents in the same manner as the first, into the shoot *b'* leading into the second fanners *a'*. The velocity at which such elevators move is usually from 150 to 180 feet per minute.

(1796.) *The second Fanners.*—The position of the second fanners is subject to endless variety, arising from the arrangement of the machinery and the point from which the motion is taken to drive them. That which is here adopted *a'*, fig. 319, Plate XIX., is one by which the motion is easily obtained; and in the case of a preference being given to hand driving, the position is equally convenient. The more minute details of this will be also given under barn utensils.

(1797.) The ultimate utility of working the second fanners, and, still more, as practised by some farmers, a third fanner, by the same power that is employed to thrash, is a question still unsettled. The operation of riddling, which is generally required for the grain as it comes from the clean-spout, has not yet been very satisfactorily performed by machinery, and to put it through the second and third time, without riddling, will seldom produce a perfect sample. The difficulty may be got over by removing the clean elevators from the spout and make them lift from the heap riddled by hand; but even were this done, there is a defect in the process, arising from inequality of blast, owing to the motive power, from inequality of feeding, not having at all times a uniform velocity, which is a circumstance not easily overcome. The most perfect system of dressing with the fanners is that where, water being the power, a small water-wheel is employed to drive the second and third fanners alone; and where water is abundant this may be practised simultaneously with the thrashing, or, if scarce, the dressing is performed as an after operation.

(1798.) An ingenious method of equalizing the blast of thrashing-machine fanners, was adopted by Mr Andrew Sharpe, Hilton, near Dunfermline, previous to the year 1835, for a description of which he received the Highland Society's silver medal. The invention consisted in placing a hinged flap, in

form of a valve, in the wind-passage of the fanners, occupying the entire width of the passage, the flap being adjusted to occupy a certain position when the fanners was emitting the due force of blast; but if this was increased by any acceleration of the motive power, the first effect of the acceleration was to increase the area of the wind-passage by raising the flap. The flap, by means of levers and rods, being placed in connection with a pair of light folding doors attached to the eyes of the fanners; the same cause that produced the effect on the flap, tending to enlarge the wind-passage, produced at the same instant, through the medium of the levers and rods, a counteracting influence, by closing the folding doors, and thereby decreasing the aperture of the eyes, and, by consequence, the volume of air entering by them, thus tending to preserve a uniform intensity of blast. The principles of this apparatus seem to be sound, and there appears no reason to doubt that a due adjustment of them would effect a decided improvement in fanners driven by a variable power.

(1799.) *Machine with chain-geering.*—I have now described the thrashing-machine as driven by wheel-geering, in full detail; there remains only to say a few words on the method of chain-geering. Fig. 320, Plate XIX., is an elevation of a machine fitted with chain-geering. In this figure *a* is the wall separating the corn from the straw-barn, *b* the foundation beams, *c* the frame-work of the machine, and *d* the feeding-board, exactly the same as before; *m* and *n* are the spur-wheels (1764.) intermediate to the power, and the great spur-wheel *e*. This last wheel having a velocity of 65 revolutions per minute, there is placed upon its shaft a chain-wheel of 10 inches, for the purpose of driving the feeding rollers. A pitch-chain *f* is passed round this wheel, and also round one of the same diameter *g* on the driving-shaft of the feeding-rollers; this chain and wheel *g* give motion to the same train of geer as described, fig. 323, which can be proportioned as detailed in (1765–66–67.). The mitre-wheels, however, are wanting, which in this mode of driving could only be of use for reversing the motion of the rollers, an operation which is often thought of little value, for if straw is once allowed to wrap around the rollers, it is easier to cut it off than to unwind it; this single chain then accomplishes the whole work of the feeding, and is perhaps the best and most simple method that can be adopted.

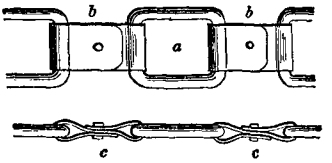
(1800.) The *drum* is driven by a pinion *h*, as already described in (1769.), a chain, under the circumstances, being inapplicable to the purpose.

(1801.) The *shakers* are both driven by the chain *i i i* which passes over the wheels *k k* on the first and second shaker shafts, and also over another wheel set upon the shaft of the spur-wheel *e*; and for the purpose of keeping a due degree of tension on the chain, a small movable tension pulley is applied. This provision for keeping the chain in a proper degree of tension is the more required in this particular arrangement, wherein the chain, in passing over the wheel of the first shaker, touches only a small part of its circumference, and unless under proper tension, the chain would be liable to start over the studs of the wheel. The proportions of the shaker wheels to that upon the shaft of the spur-wheel, must be attended to in order to bring out the proper velocities, as given at (1790.). It will readily occur to the reader, that the same results will be obtained by using two chains, and two chain-wheels on the shaft of the first shaker. In such arrangement, the first chain passes over the wheel on the main shaft of *e*, and also over one of those on the shaft of the first shaker. The second chain passes round the two wheels *k k*. The chain-geering is extremely simple, and if made sufficiently strong, will work very satisfactorily; but unless

attention is paid to due strength, and that all the links are properly adjusted to length, the chains are sometimes liable to failure.

(1802.) *Pitch-chains.*—Pitch-chains are of two kinds, the *buckle-chain* and the *ladder-chain.* The first, fig. 332, is formed of links *a* of an oblong shape, forged and welded out of round iron; the strength of which, for shakers, may be $\frac{7}{16}$ inch diameter; these alternate with flat links *b* formed of the strongest hoop-iron, 1 inch in breadth; and these are folded in the form, as represented by *c c*, which is the chain, viewed edge-ways, the flat links being secured by means of one rivet, passing through the three parts of the link.

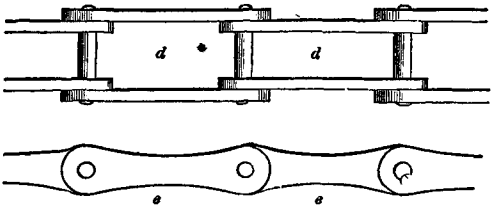
Fig. 332.



THE BUCKLE PITCH-CHAIN.

(1803.) The second, or ladder-chain is represented in fig. 336. In it the links are all of one size and strength, and, when formed, has the appearance as

Fig. 336.



THE LADDER PITCH-CHAIN.

seen at *d d*, where they are arranged in pairs, inward and outward alternately, the pins or rounds passing through two links at each end, and riveted; *e e* is an edge view of this chain, the links being worked on one edge to the curvature of the wheel, and are, in like manner, curved on the opposite, for uniformity and lightness. This form of chain is the stronger and more durable, but at the same time the more expensive of the two; and both examples are on a scale of 3 inches to 1 foot. Numerous other forms of chain are employed in the practice of mechanics, but as they seldom or never come under the agricultural branch, it is unnecessary to do more than thus advert to them.

(1804.) The construction and principles of the thrashing-machine, as used under the Scotch system, having been now fully considered, I proceed to the consideration of the *powers* usually employed to impel the machine; of these powers I shall begin with steam, as now the most important. Of steam it may well be said that every day brings to light some new application of its unlimited though child-like controllable power. But a few years have gone by since its introduction to the farm, but the rapid multiplication of it for the purpose of thrashing, shews its high value when so applied; and it is safe to say that its usefulness there is only beginning to be known, though its powers as yet are applied to little more than the simple operation of thrashing.

(1805.) Of the three kinds of steam-engine, the atmospheric, the condensing, and the non-condensing, the two latter only are employed on the farm, and even the condensing engine but sparingly. Though the condensing engine is

seldom resorted to for agricultural purposes, there is no reason why it should not be considered the best and safest; and though the most expensive in first cost, yet when tear and wear of boiler, and expense of fuel, caused by the non-condensing engine is taken into account, the difference will ultimately be very small, if any difference does exist. Perhaps the greatest obstacle to the adoption of the condensing engine on farms, is the larger expenditure of water required for it; and, though, considering the extensive drainage on all well managed farms, one would expect a moderate command of water, yet the reverse of this is the real state of the case on a large proportion of arable farms. There can be little doubt, however, that should the desire for condensing engines ever arise, the means will be found neither distant nor difficult, to procure an adequate supply of that element which alone inherits the power. As the condensing engine is so seldom employed on the farm, it has been considered unnecessary to enter into any description of it in detail, but, at the same time, the few following remarks are thrown out for the information of those who may possess, or who wish to possess, that more perfect machine.

(1806.) *The Condensing Steam-Engine.*—The low-pressure or condensing engine, for both names are equally appropriate, is distinguished from the non-condensing, chiefly from the circumstance, of the steam being condensed into water, immediately after it has performed the office, of impelling the piston from the bottom to the top of the cylinder, or *vice versa*. It is difficult to convey to the non-mechanical reader a just conception of this process of alternate action, but an idea of it may be conceived from the following statement: The vessel denominated the *cylinder* is closed, steam-tight, with a lid. The *piston* fits the interior of the cylinder, also steam-tight, and has a rod or stem attached to its centre, passing through a steam-tight stuffing-box formed in the lid. The pipe that conveys the steam from the boiler may be conceived to divide into two branches, within a chamber, before it reaches the cylinder, which they enter through the sides at top and bottom. At the point where these branches separate, they are brought into juxta position with a third opening, that stands in immediate connection with a second vessel called the *condenser*. A sliding concave cover is now so adapted to these three apertures as to be capable of opening a communication between the boiler and either of the two first, which I shall call A and C, A being in communication with the top and C with the bottom of the cylinder, while the third opening, B, leads to the condenser, but, by means of the slider, can be placed in communication with either A or C, that is to say, with the top or the bottom of the cylinder; and whenever a communication is opened between B and A, then C is open to the boiler; or if B and C are made to communicate, then A is open to the boiler. For the more easy comprehension of this see fig. 336, Plate XXIV. Suppose the latter position to exist, and that the piston is at rest near the top of the cylinder, steam will rush through the pipe and open passage A into the upper part of the cylinder, and by its elastic force will cause the piston to descend. When it has nearly reached the bottom of the cylinder, the slider is made to change its position, and now places the passage A in connection with B, while C is placed in communication with the boiler. The condensing vessel B, previously empty, and being kept constantly cool by the application of cold water, externally covering its whole surface, and internally entering it as a jet, receives the steam returning through A, and finding no resistance to its passage into B, rushes thence, and is instantaneously condensed into water, leaving the upper part of the cylinder nearly a vacuum. At the same

instant, steam from the boiler will flow through the pipe and passage C, which, acting upon the lower side of the piston, will cause it to ascend, and there being no resistance above the piston, it will be moved by the whole elastic force of the steam, which, in engines of this principle, will be about 16 lb. on the square inch of the boiler. When the piston has nearly reached the top of the cylinder, the position of the slider is again changed, so as to open the communication between the bottom of the cylinder through C and the condenser B, and likewise the communication between A, the top of the cylinder, and the boiler. The steam last introduced into C will now return into the condenser, and be again reduced to the state of water, while a fresh charge of steam from the boiler passes into A, by which the piston is once more made to descend. A few repetitions of such reciprocation would so fill the condenser as to render it ineffective; but to obviate this, the *air-pump*, so called, is added as an essential appendage to the condensing engine. The air-pump is placed in connection with the condenser; its principle, as regards its connection with that vessel, is in effect the same as the common sucking-pump, but it is furnished with an additional valve above the range of its piston, communicating with a superstratum of water during the ascent of the piston, and shutting off that communication during the descent; and its duty in this engine is to withdraw both condensable and incondensable matter from the condenser, so as to preserve in that vessel a *vacuum* as perfect as circumstances will admit of. By the help of the air-pump, then, a constant repetition of the reciprocations of the steam-piston is preserved, and motion continued through the action of the beam, crank, &c. After the condenser and air-pump, the other parts of this engine are essentially the same as in the non-condensing engine, excepting certain modifications in the apparatus of the boiler, arising from the inferior degree of steam-pressure employed in the one as compared with the other.

(1807.) In the condensing engine the *pressure* of the steam seldom exceeds 4 lb. on the square inch, more generally 2 lb., but this is to be understood as the pressure in the interior surface of the boiler, above that of the atmosphere, which is acting externally on its surface with a pressure equal to 14 lb. on the square inch; in effect, therefore, the expansive force of the steam is equal to 16 or 18 lb. on the square inch, in any situation where the atmospheric pressure has been removed. I have endeavoured to shew how this atmospheric pressure is destroyed or removed within the sphere of the condenser, which extends also to the top and bottom of the piston alternately, by the formation of a vacuum there, more or less perfect. When perfect, and the surfaces of all the parts with which the steam is in contact are kept at a temperature equal to that of the steam, the pressure on the piston will be 16 or 17 lb. on the square inch; this, however, can never be fully attained—and the loss of force from this, and various other causes, arising from the friction of the working parts of the engine—through loss of steam by condensation, in passing to the cylinder, &c., has been ascertained to reduce the effective pressure to 9 lb. on the square inch of the piston,* which is the clear available power of the engine. This conclusion, applied to an engine for farm purposes, would indicate a cylinder of about 12 inches in diameter to produce six-horse power, which is the power usually adopted on the farm. The consumption of steam by a cylinder of this calibre, after allowing for waste, would be 190 cubic feet per minute, or 11,400 per hour, and the water to supply this evaporation, at the temperature required in the boiler to produce steam of the

* Tredgold on the Steam-engine, p. 206.

pressure here supposed, would be 7.6 cubic feet, or nearly 50 gallons per hour. The water required for steam in the condensing engine is small in quantity compared to that required for condensation, and although the condensing process may be carried on with less than what may be considered a full supply, the water thus saved is acquired at a sacrifice of the steam power; in other words, the engine is caused to work with a less perfect vacuum, which, counteracting the impulse given by the steam to the piston, destroys a portion of the effective power. The quantity of cold water required for the most perfect practicable condensation is allowed to be about 24 times the quantity converted into steam, or 1200 gallons per hour, equal to 20 gallons per minute for a 6-horse power engine, and, including that for steam, 21 gallons nearly. With a view, therefore, of setting down a condensing engine, the very first point requiring to be ascertained is a *supply of water;* and unless this can be obtained in such quantity as above stated, it will appear doubtful whether or not it be advisable to adopt an engine of the kind. But the requisite supply of water may be considered in another point of view. It is seldom that a farm engine is required to work for more than one day of 12 hours continuously; the quantity of water required for that period would be 15,000 gallons, or upwards of 2300 cubic feet. A reservoir would thus be required, sufficient to contain at least one half of this, which might be collected during the 12 unemployed hours of the 24. That is to say, if the constant supply were equal, in round numbers, to 1200 cubic feet in 12 hours, which is a little more than 10½ gallons per minute, this quantity, by storing it up during half the day, would supply the engine with full water during the remaining half. The capacity of the reservoir must necessarily be sufficient to contain this half supply, and, for this purpose, it would require 900 square feet of area and 2½ feet of depth, or any other suitable dimension, to bring out the capacity. By returning the water into cooling ponds, and nearly the whole of it can be returned, as is done in many cases, especially in towns, a supply greatly below this could be made to serve the purpose. In adopting such a system, however, the cooling ponds, to which the water is returned at a temperature varying from 100° to 130°, must have a surface so extended that no portion of the water may be required to be returned to the engine until its temperature has been reduced to less than 70°. If condensation is attempted with water of a temperature much above 70°, either the quantity so applied must be very large, or the temperature in the condenser must be high; the former implies a great consumpt of water, the latter a loss of effect from imperfect condensation. These are important considerations in the use of the condensing engine, where water is scarce; but to follow them out here is not our purpose. The inquiring farmer and mechanic will find ample details on this, and all other points of the steam-engine, in the works of Tredgold, Farey, and others, which are devoted entirely to it.

(1808.) *The Non-condensing Engine.*—Steam-engines of this, as well as all the other species, are constructed in a great variety of forms, but for some time past, for farm purposes, they have been chiefly confined to two—the beam and the over-head-crank engine—and to these two I shall confine my observations, and first to the crank-engine.

(1809.) *The Crank-engine.*—In the non-condensing engine, the circulation of the steam from the boiler into and out of the cylinder is precisely the same as has been described for the condensing engine, until the steam arrives at that point where it entered the condenser. There being no condensing-apparatus in the engine now under consideration, the passage that, in the former, led to the condenser,

leads in this directly to the atmosphere, into which the steam is discharged at every half stroke of the piston. An engine on this principle is, therefore, a machine of extreme simplicity, compared with the former; and on this account chiefly, has its adoption in agriculture become so general. Figs. 325 and 326, Plate XXI, are two views of this engine, the first being a front, and the second a side elevation, without the boiler. The motions of the steam have been already adverted to; and here it is now only necessary to observe, that the column *n o* becomes, in this arrangement, a part of the steam-pipe. The pipe leading from the boiler joins it at *n*, from whence the steam descends to *o*; and passing through that branch and the throttle-valve case *l*, it enters a channel that half embraces the cylinder, and opens into a small steam chest that contains the slider formerly alluded to, (1806.), called the slide-valve, or D slide. This, in fig. 325, is concealed behind the cylinder, and in fig. 326 it is also hid behind the column; but in fig. 336, Plate XXIV, the arrangement is seen in section, as will afterwards be described. The steam chest covering the slide being thus in communication with the boiler, the steam, from its elasticity, is always ready to flow into any channel that is opened for it. Hence, as the slide is moved alternately from off the passage leading to the upper and to the lower ends of the cylinder, the piston is made to reciprocate between the top and bottom. At every change of the slide, the passage leading to the atmosphere is put in communication with the top or with the bottom of the cylinder, and the steam—which had, in the previous stroke, done its duty on the piston—is drawn off and discharged through a channel corresponding to that by which it entered; and, passing through the branch *q* into the column *q r*, it is discharged into the atmosphere by the pipe *r*, which frequently terminates in the chimney.

(1810.) To follow out, in the first place, the results of the circulating system in this engine, as has been done in the former, we have to consider the amount of power from a given area of piston and given pressure of steam. Unfortunately, there is a wide difference of opinion as to the rule for determining the power of non-condensing engines; for while some hold an area of 80 circular inches of piston as equivalent to 6 horse-power, others allow an area of 120 of the same inches as requisite to bring out the power of 6 horses. It is more than probable that these discrepancies have arisen from the circumstance of the motive power, in this case, being of such a variable nature; for it is so easy to change the force of steam in the boiler from 25 to 30 or 35 lb. on the inch, that the real power becomes quite a nominal quantity. There appears to me a source of error, also, in the rules given by writers for finding the power of non-condensing engines, by their not making proper allowances for that portion of the original force of steam in the boiler which is lost by friction of parts, &c. Thus, Tredgold, in his rule for finding the power,* gives a cylinder of 11 inches diameter for 6 horse-power, with steam of 24 lb. in the *circular* inch, which is equal to 30 lb. on the square inch. But experience goes to shew that this is too low a calculation; and by a rule which I conceive to be near the truth, an engine with 11-inch cylinder is nearly 7 horse-power. What I conceive to be the ground of this error is the allowance made for the resistance of the atmosphere to the steam, as it is discharged from the cylinder. From the rapid discharge of the steam into the atmosphere, and its natural condensation there, it may be inferred that an artificial atmosphere is formed, which extends as far as the limits of this

* Tredgold on the Steam-Engine, p. 84.

discharge, and of considerable rarity, exerting an influence, as near as I can estimate, equal to only one-half the natural pressure of the atmosphere, or 5.75 lb. on a circular inch. With this element, and taking the loss of expansive force between the boiler and the piston at the usual calculation of 4-tenths of its pressure in the boiler, leaving 6-tenths as the effective pressure,* I have the following rule.

Multiply the square of the diameter of the cylinder in inches into 6-tenths of the entire pressure of the steam in the boiler in lb. on the circular inch, *minus* half an atmosphere, or 5.75 lb., on the circular inch; and the product by the velocity of the piston in feet per minute. The last product is the power of the engine in lb. raised one foot high per minute; and for the horse-power divide as usual by 33,000. For example,

Let the cylinder be 9 inches diameter, the length of stroke 20 inches, and the number of strokes per minute 64, being equal to a velocity of 214 feet per minute for the piston, and the pressure in the boiler 25 lb. on the circular inch, equal to 32 lb. on the square inch nearly; then, $(.6 \times 25) - 5.75 = 9.35$; and

$$\frac{9^2 \times 9.35 \times 214}{33{,}000} = 5 \text{ horse-power nearly.}$$

(1811.) This rule will be found to hold with sufficient accuracy in any non-condensing engine working with steam at full pressure, with the slide opening and shutting gradually by a common eccentric motion. Other methods, however, of admitting the steam to the cylinder are frequently adopted, and to which the above does not apply; such as the method by expansion, wherein the admission of steam is cut off at some point of the stroke, prior to its termination, the steam already received acting by its own expansive force through the remainder of the stroke. This method effects a great saving of steam, and, consequently, of fuel; but being seldom resorted to in the purposes of steam-power now under consideration, it seems unnecessary to follow it out in this place. Another method, which is the converse of this, has also been adopted—the admission at complete full pressure, during the entire stroke, or very nearly so. This is accomplished by opening and shutting the slide, not gradually, but by starts, with stationary intervals. By this method, the consumpt of steam is greater than in the common way; but the power is said to be in greater proportion.

(1812.) By the rule given above for the power of non-condensing engines, a cylinder of 10 inches diameter, with a pressure of 25 lb. on the circular inch, and making 60 strokes per minute, is equal to 6 horse-power; and the piston will move at a velocity of 214 feet per minute, making the consumpt of steam, allowing for waste, equal to 128 cubic feet per minute, or 7680 per hour. The proportion of water to steam, consumed at this pressure, is about 1 to 850, or a little more than 9 cubic feet of water, being about 57 gallons per hour for the supply of the boiler. This calculation is stated merely to shew how small the quantity is that suffices for a non-condensing engine of six-horse power.

(1813.) The complicated passage of the steam through the cylinder has been alluded to; but considering how important it is that the farmer should have a competent knowledge of the machinery with which his business is carried on, I

* Tredgold on the Steam-Engine, p. 84.

shall endeavour to render this part of the subject still more definite, by a reference to fig. 336, Plate XXIV. This is an enlarged section of the steam cylinder and slide-valve, with its case. *a* is the cylinder, *b* the piston, *c* the piston-rod, and *d* the cylinder-cover, with the stuffing-box through which the piston moves, steam-tight; *e* is the steam-passage to the upper side of the piston, and *f* that to the lower side: these passages lead from the steam-chest *g*. The steam-chest or valve-case is attached to the cylinder in such a way, as to embrace the three openings, formerly described (1806.), A, B, C. The case *g* contains also the slide *h*, to which is attached the slide-rod *i*, passing through its stuffing-box in the cover of the case. The slide-rod is acted upon by the eccentric on the crank-shaft, which is so adjusted as to move the valve at the precise time and place required for the due admission and emission of the steam to and from the cylinder. In the figure, the slide is in the position that connects the opening C with the opening B; or, in other words, the passages are open that allow the steam under the piston—which is now upon its descent—to escape in the direction of the arrow, through B, into the atmosphere; while the steam from the boiler enters the case by the aperture *k*, and passing directly to the opening A, passes through *e* into the cylinder, causing the piston to descend. When the piston has reached near to the middle point of its stroke, the slide begins to move from its present position; and when the piston has reached within one or two inches of the bottom—for this varies according to the views of the engineer—the orifice A will have been shut off from its connection with the case *g*, and immediately thereafter the orifice C is opened into *g*, the connection between C and B having, in the short interval, been cut off by the movement of the slide; and previous also to the commencement of the piston's ascent, the communication between B and A is opened by the same movement, permitting now the steam above the piston to escape through *e* and B to the atmosphere. This new position of the slide causes the *ascent* of the piston, and a repetition of the movements in the reverse order, produces again the descent of the piston, and so on.

(1814.) To return to the structure of the crank-engine, the parts of which it consists may be described as follows. *a a* is the wall separating the engine-house from the barn, *b b* the level of the engine-house floor, and *c c* the sole-plate on which the superstructure of the engine is raised. The sole-plate is bolted down to a mass of solid masonry, to give it perfect stability. The masonry usually consists chiefly of two blocks of stone, each about 5 feet in length, 2 to 2½ feet in breadth, and at least a foot in depth; these are laid upon a foundation of coursed masonry, from 1 to 2 feet in depth, as the locality may require, and the bolts pass down through all. The two columns *d* are secured to the sole-plate by two of the above-described bolts, which take hold of the column by means of strong cotterels passing through the column and the bolt; which last is secured under the masonry by a screw-nut or by a cotterel. The top of the columns are secured in various ways, but, in the present case, it is by means of a beam of cast-iron *e e*, forming an entablature which extends across the engine-house, and rests at each end in the walls; the connection between this and the columns being also effected by bolts and cotterels. A guide-bar *i* extends between the two columns, through which the head of the piston-rod passes, to preserve its parallelism; and this constitutes the whole frame-work of the engine. The working parts remaining to be described consist of the connecting-rod *h*, which joins the piston-rod with the crank *k*, which last is firmly fixed upon the crank or main shaft *l*, which has its bearings in the beam *e* and wall *a*. The

fly-wheel *m* is placed upon the crank-shaft, its purpose being to equalize the motion of the engine. It is necessarily of considerable weight, and the diameter should not be less than 8 feet; the section of its rim being equal in area to 16 square inches, yielding a total weight of from 14 to 15 cwt.

(1815.) Tredgold has given a rule for determining the *weight of a fly-wheel* in the following terms. "Multiply 40 times the pressure on the piston in pounds by the radius of the crank in feet, divide this product by the cube of the radius of the fly-wheel multiplied into the number of its revolutions per minute, the result is the sectional area of the rim of the fly in inches." To apply this rule to the case before us (1812.), we have the pressure on the piston, which is 10 inches diameter, equal to $10^2 \times 25 \times .6 = 1500$ lb., radius of the crank .91 foot, radius of fly 4 feet, and making 60 revolutions per minute, then $\frac{1500 \times 40 \times .91}{4^3 \times 60} = \frac{60{,}000}{3840} = 15$ inches nearly, which gives a weight of rim equal to about 11 cwt., and, with the eye and arms, will amount to 14 or 15 cwt. as before stated.

(1816.) The crank-shaft carries also the two eccentrics at *y*, the one for the pump-rod *z*, to which is jointed the plunger *a'* of the pump for supplying water to the boiler. The other eccentric moves the slide-valve-rod seen between the column and the pump-rod; and the shaft likewise carries the pair of bevel-wheels that give motion to the governor *t*. The governor is supported at bottom on the bracket *u*, and at top runs in a collar of the V bracket *v*, bolted upon the beam *e*.

(1817.) The essential parts of the *governor* are the two oblique rods with the balls attached at their lower extremity; and these being suspended by a joint on the vertical axis, the whole is rendered capable of revolving horizontally upon that axis. In this form it is known as the conical pendulum, and was first applied as a regulator of the steam-engine by Watt. If the vertical distance between the points of suspension of the rods, and the plane in which the centre of gravity of the balls and rods revolve, be made the same as that of the common seconds pendulum; and the balls be made to revolve, they will have no tendency either to rise or fall by their centrifugal action, if each revolution is performed in two seconds, being the time that a common pendulum takes to make a vibration forward and back to the same point, or 30 revolutions in a minute. It is this principle that gives the conical pendulum value as a regulator; for, if the machine that gives motion to the governor is accelerated, from a reduction of resistance, or other causes, the revolving balls partake of the acceleration, and the centrifugal action, thus generated, gives them a tendency to fly off from the centre of revolution. This outward motion is converted into the means of regulation, for while the balls and rods extend their circle of gyration, they act upon the two jointed arms, which meet in the sliding piece *t*, where they are also jointed, and *t* is drawn upward. A lever is frequently attached to *t* by a fork; but, in this example, the lever *w* is applied to the collar above the joint of the rods, and this collar being connected to *t* by two slender side-rods, they move together, and the lever *w* being suspended near its centre, has the opposite extremity jointed to the rod *x*, the lower end of which acts upon the lever of the throttle-valve. In small engines, the arms of the governor are never made equal in length to the seconds pendulum, but of such length as will accord with velocities of 40 or 45 revolutions per minute; and the length of arm to produce this is easily found

by the common rule for the length of pendulums,—their vibrations being as the square root of their length,—and the revolutions of the conical pendulum being half the number of vibrations of a common pendulum of the same length.

(1818.) The *throttle-valve*, to which the effects of the governor are directed, is a thin circular plate of metal, having an axis fixed across its diameter, and is nicely fitted into the steam-way, passing through the case *p*. The spindle passes through the sides of the case steam-tight, and carries on one end a small lever by which the valve can be turned; and the lever is put in connection with the lower end of the rod *x*. The extension of the balls of the governor acting on the slide *t*, and from that, through the lever and rod *w* and *x*, depresses the lever of the valve, and by thus turning the valve, reduces the steam-way, and prevents further acceleration of the machine.

(1819.) In *setting down the engine*, we have to consider the space necessary to receive it. This, in the direction of the barn wall, need not be larger than 8½ feet, or a few inches more than the diameter of the fly-wheel; the breadth, in the other direction, should not be less than 8 feet, but may extend to 9 or 9½ feet. An engine-house, therefore, of the form and dimensions afforded by the plan fig. 4, Plate IV., is not well adapted to this form of engine, its length, in the direction of the barn, being too great for the entablature beam; and if adopted for such a form of house, a wall must be run up, reducing its length to 8½ feet, or thereby. In almost every case, this form of engine is the most commodious for its application to a thrashing-machine, especially in regard to the dimension of height; for the height that the crank-shaft stands above the floor of the engine-house will generally bring it near to the large spur-wheel, which, though not in all thrashing-machines, is yet to be found in a large majority of them. This is supposing that the floor of the engine-house is nearly on a level with the barn floor, which will generally be the case, unless artificially changed.

(1820.) *The Beam-engine.*—In reference to the beam-engine, the mode of action of the steam in its passage to and from the engine, the quantity of steam and of water, the power, the regulating and governing, and, indeed, every essential principle, being common to it and the crank-engine, it becomes unnecessary to say more than merely to point out the difference in construction. Figs. 327 and 328, Plate XXII., represent the beam-engine of 6-horse power: the first being a plan, and the second an elevation, and, as before, the same letters refer to both figures. The sole-plate, marked *a*, is bolted down to the seat, consisting, as before, of solid masonry; but in this case the pit extends to a distance equal to that between outside and outside of the end columns, the width being about 20 inches, and the depth varying from 3 to 7 feet, according to the position of the barn and the engine-house, and of the large geering. The bolts that secure the sole-plate lay hold also of the columns *b*, fixed with cotterels as before. c is the entablature-frame, bolted to, and securing the heads of the columns. To this is bolted the carriage, of the main centre of the engine beam *h*. A small portion of the wall that separates the barn from the engine-house is marked *d*. The cylinder is marked *e*, *f* is the piston-rod, and *g g* the parallel motion,—the medium of connection between the piston-rod and the beam. *A parallel or rectilineal motion* of some sort is a necessary appendage to the beam-engine; for, as the extremity of the beam, in its vibration, describes an arc of a circle, while the piston-rod must describe a rectilineal course, a direct junction of the two is incompatible; hence the absolute necessity of some medium being interposed to

allow the two to act in concert. This object is attained by the parallel motion here figured, which was, in its original form, the invention of Watt; and, though it appears under various modifications, they may be all reduced to one principle, the object of which is, to procure a point or points in the construction that shall describe a straight line. In the figure, the point to which the piston-rod is attached, and also that to which the pump-rod *h'* is attached, possesses the property within certain limits. Though this arrangement of parts goes by the name of the parallel motion, it is only within certain limits that the motion of the points alluded to preserves a strictly rectilineal course; and towards, but especially beyond the limits, the deviations are very considerable, going on with increasing deviation, till the motion of the point ends in a returning curve or loop. Notwithstanding this apparent defect, the motion is sufficiently perfect for all practical purposes, provided the longitudinal axis of the beam *h*, in the extreme points of its vibrations, does not subtend an angle exceeding 36°.

(1821.) That end of the beam which is opposite to the parallel motion, has the connecting-rod *i* jointed to it, and the latter is connected to the crank *k* by means of the crank-pin or journal, which turns within a bearing in the lower end of *i*. The crank is firmly attached to the main or crank shaft *l*, which is supported in two plummer-blocks, one in the sole-plate *a*, and one upon the wall *d*, and it also carries the fly-wheel *m*, of dimensions similar to that formerly described. As will be seen from the various figures, the fly-wheel in this engine is nearly half immersed in a pit formed for its reception.

(1822.) Regarding the circulation of the steam in this engine, it enters by the pipe *n*, fig. 327, passing through the throttle-valve case *p*, and, after performing its duty in the cylinder, is discharged through the pipe *o* into the atmosphere, either directly or through the chimney. The lever of the throttle-valve is marked *q*, and *r* is the top of the slide-valve case; *t t* the eccentric rod, acted upon by an eccentric placed on the crank-shaft, over which the circular extremity of the rod *t* passes, and by its alternate action causes the vibrations of the wiper by the arm *u*, fig. 328, and whose opposite arms are jointed to the cross-head at *v* of the slide-rod *r*. The small beveled wheel *w*, on the crank-shaft, gives motion to the upright shaft *y* of the governor; and the saddle-shaped carriage *x*, which spans over the crank-shaft, forms a foot-step for the governor-shaft, while its upper journal is supported in a bracket projected from the entablature, but is hidden from view in the figure. The governor is partially seen at *z* in fig. 328; its construction is the same as that formerly described, and its motions are communicated to the safety-valve through the rods *a'* and *b'*.

(1823.) The *pump* for supplying water to the boiler is attached to the sole-plate by means of the cross-bar *a a*, fig. 327; and in both figures *c'* is the pump-chamber, *e'* the case of the upper valve, *d'* the case of the lower, and *f'* is the suction-pipe proceeding to the well or cistern, while *i'* is the pipe which conveys the supply to the boiler. Pumps of this kind are generally worked on the principle of forcing, with a solid piston or plunger, which is here represented at *g'*, and is connected by a socket and key-joint to the pump-rod *h'*.

(1824.) The setting on and stopping the non-condensing engine is an exceedingly simple operation; and its simplicity is even simplified by the addition of a cock or valve on the steam-pipe, which is very frequently adopted, and in that case the throttle-valve is not required to be so accurately fitted as where no stop-cock is employed. To *set on the engine*, the steam must first be brought up to the requisite degree of pressure. When this is accomplished, which is

known by the safety-valve, described in (1834.), rising so as to allow the escape of steam, the stop-cock, if there is one, is opened, the throttle-valve being also open; the steam is admitted both above and below the piston, by moving the slide with the handle of the wiper-shaft, to heat the cylinder, the eccentric rod being at the time disengaged from the shaft. This done, the *gab* of the eccentric-rod is laid upon the arm of the wiper-shaft; and, if the crank is in a horizontal position, the engine may start off without assistance; but, if it does not move, the fly-wheel is to be pushed round a few feet, or until the crank has once passed the *centres*, when it will move on freely. If no resistance is upon the engine, the throttle-valve should be put nearly shut, but so soon as the resistance comes,—the commencement of thrashing, for example,—the throttle-valve lever is to be connected to the vertical rod *b'*, and the work will proceed regularly.

(1825.) In *stopping*, where there is a stop-cock, the shutting of it puts a stop to further motion, except what the momentum of the parts may continue to give out for a few seconds; where there is no stop-cock, the first step is to disengage the throttle-valve lever, and close the valve, and immediately after disengaging the eccentric rod from the wiper-shaft, the engine will stop. It is advisable to keep this rod disengaged at all times when the engine is standing.

(1826.) As the engine-house is seldom accessible directly from the barn, there ought always to be means established for communicating a signal between the two places; and this should proceed from the chief of the operation,—the person who feeds the machine. As there can be but two propositions to make, —to set on, and to stop,—one signal is sufficient, and a *bell* seems to be the most convenient medium of communication.

(1827.) *The Boiler.*—Of all the parts of the steam-engine, the boiler, though by far the simplest in its construction, is the most important. In it is generated the agent of power, while all the other parts are merely the accessories and media through which the effects of the mighty agent are developed. It has constantly, while in action, to resist this imprisoned and powerful agent, and that merely by the strength of its parts; hence the necessity for having boilers made of the best possible materials, and those connected in the best possible manner.

(1828.) The form now most generally adopted for the boilers of farm engines, and it is undoubtedly the best, is the plane cylindrical boiler, with hemispherical ends. The Staffordshire plate is considered the best for the purpose; and they are generally bent to the circle in the cold state, by the aid of a machine. The joinings are all effected by riveting with short bolts of $\frac{5}{8}$ inch diameter, the plates being previously punched by a machine for the reception of the rivets. The rivet-bolts are inserted and riveted down in the red-hot state, so that, besides the effect of the riveting to draw the contiguous surfaces of the plates into close contact, there is the powerful contraction of the iron, while cooling, to produce still more perfect contact. To ensure perfect tightness in the joinings or *landings*, technically so called, the whole of the joints, after they are all riveted up, undergo a process of caulking, which is simply the stamping up the edges of the plates into intimate contact with the adjoining surface, by means of flat-edged chisels struck with a hammer.

(1829.) Various rules are given for the *dimensions of boilers* corresponding to any given power of engine; but the most rational are those founded upon the extent of surface exposed to the flame of the fire, and the flame and heated

air of the flues, taken along with the cubical contents of the boiler. From researches into the relations of the fire-surface and contents, we can form a very correct value of the power of boilers from their capacity alone. According to these, a cylindrical boiler for high-pressure steam should have, in its entire capacity, 12 cubic feet of space for each cubic foot of water boiled off per hour. Now, it has been shewn (1812.) that a 6-horse power cylinder of 10 inches diameter will consume the steam of 9 cubic feet of water per hour, and $9 \times 12 = 108$ cubic feet for the capacity of boiler; and taking its diameter at 3 feet 4 inches, which gives a sectional area of 8.6 feet; and dividing the cubical capacity of the boiler by this last number, we have $\frac{108}{8.6} = 12.5$ feet for the length of a cylinder that will yield the capacity required. But as it will have hemispherical ends, the extreme length will be 13½ feet nearly, which agrees very well with practice.

(1830.) The position in which the boiler is to be set down should be as near as possible to the engine, so that the pipe conveying the steam should be as short as possible, to prevent all unnecessary condensation of steam.

(1831.) The *furnace* of the boiler has undergone many changes, both in form and dimensions, and in the means of supplying it with air for the consumption of the smoke. The latter property, though always desirable, is not of weighty importance in farm-engines; but it is essential that, in every case, the furnace be so constructed as to produce the requisite supply of steam with certainty and dispatch. To effect these objects, it is required to expose as much as possible of the bottom of the boiler to the action of the fire, without reducing that portion of the surface which falls to receive the heat from the flame and smoke passing along the flues. In cylindrical boilers, this is effected by making the width of the furnace equal to three-fifths of the diameter of the boiler, the covering of the side flues rising to within 2 inches of the level of the centre of the boiler, that being the line to which the sinking of the water should be restricted, so that the fire or heated air shall never impinge on any part of the surface that is not covered internally with water. The area of fire-grate commonly allowed is one superficial foot to each horse-power; or, if the furnace is 2 feet wide, the grate-bars should be 3 feet in length. This I hold to be too small, unless coal of the very best quality is burned; and to ensure abundance of fire, the bars should be of such length as to give 1½ square foot to the horse-power nearly, and should be laid with a slope of 1 inch on the foot of length. In front of the bars, a breadth of from 15 to 18 inches is occupied by the dumb-plate or dead-plate, upon which the fresh fuel should always be laid down on its first introduction to the furnace. The mouth of the furnace is closed by a door and frame of cast-iron, leaving the opening of the ash-pit about 3 feet in height.

(1832.) The *chimney* for the steam-engine is an object of some importance. Upon its height and area depends much of the future effects of the engine; and very numerous are the views taken of these by engineers. The following points may, however, be taken as data not easily controverted. The height should not be less than 50 feet; and if it is desirable to avoid the nuisance arising from smoke, the height should greatly exceed this. The internal sectional area should be as large as may be consistent with economy in the expense, but should never be under 80 square inches for each horse power. Thus a chimney for a 6-horse engine should have its area at the top $80 \times 6 = 480$ square inches, and $\sqrt{480} = 22$ inches nearly, the side of the square of the chimney internally; and if circular, the diameter should be 25 inches nearly. The height of the

chimney being determined, and also the side of its square externally, the square of its base is found by adding to the length of the side at top, the amount of increase arising from the slope given to the sides. The usual slope, or battre, is $\frac{3}{8}$ inch to a foot; with a height, therefore, of 50 feet, the increase at bottom will be $18\frac{3}{4}$ inches on each side; and the walls being one brick or 5 inches thick, the side of the square at top will be $22 + (5 \times 2) = 32$ inches, and this added to $18\frac{3}{4} \times 2 = 39\frac{1}{2} + 32 = 5$ feet $11\frac{1}{2}$ inches, the side of the square at bottom.

(1833.) The figures 337–38–39, Plate XXIV, represent a plan and two sections of a *steam-boiler* for a 6-horse engine. Fig. 337 is the *plan*, the one half of it taken above the level of the boiler's bottom, the other half below that level. *a* is the furnace-door and dead-plate, *b b* the furnace-bars, and *c* the bridge or throat of the furnace, over which the flame is drawn with great force, proceeding along the flat flue *d* to the extremity *e*, where it is turned into the first side-flue *f*. The figure exhibits also the top of the boiler *g*, but without any of its furniture; *h h* is the continuation of the flue round the end of the boiler, leading into the other side-flue *i i*, which terminates in the chimney *k*; *l l* are the walls of the boiler-seat, and *m m* the flue-ports, which are movable plates, to admit of access to the flues for the purpose of cleaning. The damper *i'* is a metal plate suspended by a chain, and its purpose the increase or the diminution of the draught.

(1834.) Fig. 338 is a longitudinal section, in which *a* again marks the furnace-door, *b* the furnace-bars, *c* the throat, and *d* the flat flue, *e* being the first bend of the flue, and *h* that part of it that turns the front of the boiler. The boiler *g g* appears here in complete section, *r* being the feed-pipe from the engine-pump, delivering the water near the bottom of the boiler; *o* is the man-hole door, and *p* the steam-pipe, for conveying the steam to the engine; *q* is the safety-valve, which should not be less than 3 inches diameter; and *n* is one of the gauge-cocks. The parts *l l* represent the brick-work of the boiler-seat; *m* is the ash-pit, and *n'* a closed port for the removal of dust from the dusthole *d'*.

(1835.) Fig. 339 is the cross section, wherein *a* is the ash-pit, 3 feet in height; *b* the furnace-bars; *c* the bridge; and *d* the throat, which should not exceed 8 inches in height; *e e* are the side-flues—their breadth at bottom, measuring from the sides of the furnace, should be not less than 16 inches. The boiler is here represented by *g*, and the waste steam-pipe by *p*; *o* being the clasps of the man-hole cover, *q* the safety-valve, and *n* the feed-pipe; *k* is the chimney, *l* the flue, and *m* is an entrance-port.

(1836.) The *regular supply of water* to the boiler of a steam-engine is a matter of great importance. In those for condensing engines it can be conducted with great certainty of effect, owing to the moderate degree of pressure under which they are worked; for as that does not generally exceed the pressure of a column of water 9 feet high, it is easy to establish a small cistern which is kept in constant supply, and which, by a self-acting hydrostatic arrangement keeps the supply to the boiler perfectly uniform. The higher pressure under which the non-condensing engine works, prevents the same arrangement being followed in regard to its boiler, and no method of equal simplicity and certainty has yet been devised, though various methods are in practice. Some of the methods adopted are self-acting, or so called; and others depend entirely on the attention of the engine-keeper, which appears to be the safer of the two for engines not in daily use. Under this last method, the water-pump is understood to be in constant action, and to throw a superabundance of water; and when the boiler is observed to have got a sufficient supply—which is indicated by a float water-gauge

—the discharge from the pump is turned off from the boiler, and thrown to waste or back to the well. This alteration of the discharge is effected by the attendant turning a stop-cock; but after a short practice, he is able, from observation, so to adjust the cock that the requisite supply shall go to the boiler, without entirely shutting the waste-cock. The apparatus for effecting this mode of supply is shewn in fig. 338, Plate XXIV, where *s* is the stone-float, suspended by a wire *t* that passes through a small stuffing-box in the boiler-top. The wire is attached to a piece of chain that passes over the wheel *u*, and to the end of the chain is attached the counter-weight *v*. When the float and wheel, with its chain, are adjusted to the medium level of the water, an index or pointer *w* is attached to the wheel, pointing vertically; and any change in the level of the water will be indicated by a corresponding change in the position of the pointer to right or left. In this arrangement, the *power* that produces the indication is the difference of specific gravity between the water and the stone-float, after the float is balanced by the counter-weight *v*; and this being, in some cases, not of great amount, the apparatus is occasionally liable to get out of order, from the wire not passing freely through the stuffing-box. I have adopted a method that obviates this defect, which is also represented in fig. 338. In this arrangement, *w'* is a hollow copper ball, made securely water-tight. A wire stem rises from it, and passes freely through an iron tube *y*, of $\frac{1}{2}$-inch bore which is fixed in the top of the boiler, passing 10 or 12 inches within it, and above it, to any convenient height, serving as a guide for the stem of the float; to the top of this iron tube a strong glass tube is jointed at *a'*, of about 1 foot high. The junction of the glass and the iron tubes, and the closing of the upper end of the former, are effected by a brass case, with screwed bottom and cap, which embraces the top of the iron tube and the whole of the glass-tube, slits being made in opposite sides of the brass tube, through which the indication of the index can be read off. The index in this apparatus is the top of the float stem, which being adjusted to length, and terminated in a small knob that will move freely in the tube, its indications of rise and fall are noted on a graduated scale on the brass tube.

(1837.) This method of *water-gauge* is still better accomplished, when circumstances permit of it, by the arrangement in fig. 338, Plate XXIV, by placing a small tube in the position *v' y' x'*, its lower end, shewn by the dotted lines at *v'* being in connection with the water in the boiler, and its upper orifice *x'* with the steam, so that the pressure shall be equal on both ends. A piece of glass tube *y'* is placed in the middle of the channel of communication, or in such position that the level of the limits of range for the surface of the water may fall within the length of the glass; and the surface of the column in the tube will always indicate the same level as the surface of the water within the boiler. A graduated scale placed in contact with this, the zero being at the proper working level, will indicate with certainty the state of the water within the boiler.

(1838.) These water-indicators, from the certainty of their effect and the satisfaction they are capable of affording, at all times, of the state of the water within the boiler to all parties concerned in its safety, ought to be universally adopted.

(1839.) Of the self-acting feeders for high-pressure boilers, it is not safe to trust even the very best without some auxiliary means of checking the results, such as the common gauge-cocks or the water-gauge. I have seen some of them so defective, that their boilers have been worked off almost to dryness, while it was imagined that all was going right, because the apparatus was throwing off what was considered surplus-water, while it had, in fact, been sending the whole

supply past the boiler for hours. The consequences were, the destruction of the boiler, and a narrow escape from explosion.

(1840.) It is of great importance that the water sent into the boiler should have its temperature raised as high as possible before entering. This is effected in a very simple manner, and to a temperature of about 140°, by the apparatus, fig. 340, Plate XXV, which may be placed in any position between the pump and the boiler that convenience may point out. *a a* is the waste steam-pipe, passing from the cylinder to the place of discharge in the chimney, or to the atmosphere. It is surrounded by the case *b*, which should have an internal diameter of at least 1½ inch greater than the steam-pipe that it embraces; and the aperture *e* at each end made steam-tight by a rust-joint. The small pipe through which the water is forced by the pump towards the boiler, is joined to the nozzle *c* of the case; and a continuation of the same being joined to *d*, is carried forward to the boiler, which it enters at *n*, figs. 338, 339, Plate XXIV. While the waste steam, therefore, is passing through *a*, the cold water from the pump is forced into the chamber formed betwixt the steam-pipe and its case *b*, and in its passage along this chamber to the outlet *d* absorbs a portion of heat from the steam and pipe within, and so enters the boiler at the temperature stated above.

(1841.) The *fuel* for the steam-engine is always coal, where it can be procured; but either wood or peat may be used. In the neighbourhood of coal-works, the refuse or culm is always procurable at a low price, and is quite sufficient in point of quality for an engine furnace; one cwt. of this culm will, on an average, be required per hour that the furnace is burning, for a six-horse engine. Where the locality involves a distant carriage, it is then better to use the large coal, of which, with due care, ¾ cwt. will suffice for an hour. In stoking, the coal should always be laid down on the dead-plate, pushing it forward before putting in a fresh supply. The fire should be kept clear, and always free of the clinkers that may be formed on the bars. On all occasions of stopping, the damper should be let down and the furnace-doors opened, to prevent unnecessary waste of fuel; but at all times while working, the furnace-doors must be kept shut, unless the supply of steam is found to be too great.

(1842.) *The Horse-wheel.*—Until of late years, the thrashing-machine was in most cases impelled by horses moving in a circular course, and as this power continues to be employed on the smaller class of farms, it is still of that importance to demand being here brought under notice. Horse-wheels are of various construction, as *under-foot* and *over-head;* the former being chiefly used where small powers are required, and the latter where four horses and upwards are employed. In general, in the under-foot wheel, the horses draw by means of trace-chains and swing-tree. In the over-head wheel, of old construction, we also find occasionally the same method of yoking practised; but in all modern over-head wheels the horses draw by a *yoke* descending over their back, from a horizontal beam placed over head. Custom seems, as usual, to have produced a preference for this mode of yoking, though there appears good reason for calling its propriety in question, especially if the course has a diameter of 22 feet or upwards. The argument in support of the over-head draught is, that the horse exerts his force in the direction of a tangent, or very nearly so, to the curve in which he walks, or at right angles to the beam by which he draws; while, in the swing-tree draught, his shoulders being considerably more in advance of the point of attachment, his exertions must necessarily tend in a direction that will form an angle more acute than a right angle, but which will vary with the radius of the

course. It is quite true that this is the case, and that the horse will draw at a disadvantage, to a certain extent, but the amount of this disadvantage is small. In a 26 feet course, which is a good medium, giving the over-head draught the full advantage of the right-angle—90°—the other will draw at an angle of about 72° with the radius or beam; and it is easy to shew that the amount of disadvantage arising from this is as 21 to 20. If the draught of a horse in a wheel amounts to 170 lb. under the favourable position, it will require an exertion of 178½ lb. from the same horse, when yoked unfavourably, that is, by a swing-tree. With this disadvantage, which is but small, if we compare the freedom of action and uniformity of the resistance in the case of the swing-tree draught, with the constrained action and jolting effects which the horse undergoes in the over-head yoke, and to these, if we add the chances of disadvantage to horses of low stature, being constrained to draw at an unfavourable vertical angle, we shall soon find an amount of disadvantage greater than in the former case. The question is not now of that importance that it once possessed, in consequence of the extensive application of steam, but it appears still to be deserving of consideration.

(1843.) In the construction of the horse-wheel also, a question arises as to the *diameter of the actual wheel*, whether it should be equal in diameter to the entire horse-walk, and work as a spur-wheel, or have a diameter considerably under the former, and be applied as a face or beveled wheel. It appears to me that the *large spur-wheel*, of 25 or 30 feet in diameter, has been conceived under a false impression, and that, on principle, its application is erroneous. It is also probable that a consideration of the overshot water-wheel, which, from its construction, and the nature of the element employed, requires that its power should be given off at or near the extremity of its arms, may have given rise to this formation; but the causes that combine to render this not only advisable, but imperative, in the water-wheel, if every thing is duly considered, do not apply to horse-power. When the horse-wheel has a diameter larger than the mean diameter of the horse-path, it gives the first motion a higher velocity than that of the moving power, by its more extended radius; and if any inequality occurs in the moving power, it will sensibly affect the succeeding motions. Horses do not exert a perfectly uniform force when yoked in a wheel, the very act of stepping forth, by removing the exertion from one shoulder to the other, produces small increments and decrements, alternately, to the power, and these must be communicated to the wheel which extends beyond that point of the lever by which the horse draws. Besides this effect on the machine, it must have an equally bad effect upon the horses; for, in consequence of the construction of the large wheel, and from the yoke being applied to a point where all elasticity is removed, the draft becomes what is termed *dead*, that is to say, there are no elastic or yielding parts betwixt the power and the first impulse, that might tend to soften the sudden strains that come upon the horses, unless other means are resorted to, to produce that result. Wheels of this construction will, therefore, be found more fatiguing to the horses than those of smaller diameter.

(1844.) Of horse-wheels with a *small circle of teeth*, the diameter best suited for all purposes, and which might produce a maximum effect, has not yet been defined; but, from analogy, and taking into view the properties of the centre of percussion, we may infer that the radius of the segments forming the toothed-wheel should be two-thirds of the radius of the beam, measuring to the centre of draught, which may be taken at 11 feet when the course is 26 feet diameter, giving to the toothed segments a diameter of 14 feet 3 inches. The diameter

thus found is subject to modification, arising from considerations of strength, and the too great obliquity of the diagonal braces of the wheel, that would follow upon a large diameter. Such considerations will induce a reduction of diameter to 12½ or 13 feet, as a good medium size of wheel. The projection of the horse beams beyond the point of action of the toothed segments, produce that degree of elasticity pointed out in (1843.), the absence of which forms a defect in wheels of large diameter.

(1845.) The horse-wheel represented in figs. 333 and 334, Plate XXIII, is constructed on data derived from the foregoing considerations; the first is a *plan*, and the second an *elevation* of the wheel, the same letters of reference applying to both figures. It is constructed for four horses, the course is 26 feet diameter within the pillars, and the wheel is 13 feet diameter, with a hollow cast-iron central shaft, having a flange at top and bottom 2 feet diameter, to which the arms and stays of the wheel are bolted. The position of the horse-wheel must be always adjoining to the barn; it may or may not be on the side towards the stack-yard, but generally the former. In the figures, then, the barn-wall is marked *a a*, and the two main pillars, which support the main collar-beam, are marked *b b*, the two minor pillars, erected solely for completing the bearings of the roof are *c c*, and *d* is the floor or horse-walk. The footstep of the horse-wheel is supported on the stone block *e*, the step being adjustable by four screws, to bring the wheel to the true level; and *f* is the collar-beam, 12 by 8 inches, which is laid upon and bolted to the main pillars, and carries the plummer-block for the head of the central shaft. The sheers *g g* are 12 by 4 inches, framed into the collar-beam, and resting on the wall *a a*; the dotted lines *h h* represent two diagonal braces to the sheers, to resist the shake from the action of the wheel upon the pinion of the lying shaft; and the cast-iron bridge *i* is bolted down upon the sheers carrying the end of the lying shaft. The flanges of the central shaft *k* and *l*, form the foundation of the wheel; to the latter are bolted the horizontal arms *m m*, 6 by 2½ inches, as well as the horse-beams *o*, which are 10 by 6 inches, and these are supported by the diagonals *n n*, 4 by 2½ inches, seated in and draw-bolted to the flange *k*. The horizontal braces *p p* of the horse-beams are 6 by 2½ inches; they are framed into the ends of the arms *m m*, and secured with cast-iron knee-plates at their junction with the wheel and with the horse-beams. The yoke-bars *q q* are made of hard-wood, strongly bolted to the horse-beams, and are each mounted with an iron pulley near the lower end, over which the draught-chain passes. The yoke-bars are 6 by 3 inches, and taper towards the lower ends; at the point where the draught-chain passes through them, their height from the horse-path should be 3 feet 6 inches, liable to slight variation, arising from the stature of the horse that is to be yoked into it. The wheel *r* is now always made of cast-iron, in segments, and, when the wheel is very carefully made, are fitted and bolted to a bed-plate of the same material, previously bolted to the arms and horse-beams. The breadth of the bed-plate may be 6 inches, with low flanges to keep the segments in place. The toothed segments should be 4 inches in breadth, and their pitch 2 inches, the diameter of the wheel being, as before stated, 13 feet. The horse-wheel pinion *s* is 14¼ inches nearly, in diameter, mounted on the lying shaft *s t*, whose inward bearing is upon the barn wall, in an opening formed for the purpose, and this shaft carries the spur-wheel *u* inside the barn. The calculations of this machine would stand thus:—The horses will walk the course three times in a minute, being at the rate nearly of 2¼ miles per hour, the lying shaft *s t* will make eleven revolutions for one of the wheel, or 33 per minute, and if the drum pinion, which is

driven by the wheel u, is made 8.6 inches diameter, the wheel being 7 feet, would give the drum 320 revolutions per minute; a fair average velocity for a 4-horse machine, which can be increased by a quicker step of the horses, say to $2\frac{1}{2}$ miles per hour, which would give 340 revolutions per minute to the drum.

(1846.) Some horses, when yoked in a wheel, are observed, after a short practice, to take advantage of lagging back, and allowing those who are more willing, to take the heavy end of the work. To counteract this, methods have been adopted to make the horses draw by chains, so arranged as to make them work against each other in pairs; or make any number of them draw from a ring-chain common to the whole. Another method was to make each horse draw against a certain weight suspended over pulleys; but all these have their imperfections in one way or another. A new and more perfect arrangement of the ring-chain was introduced by Mr Christie, Rhynd, Fifeshire, which received the approbation of the Highland and Agricultural Society of Scotland.* This arrangement is exhibited in fig. 333, Plate XXIII. The principle of the arrangement is, *that the ring-chain forms a figure of as many equal sides or angles as there are horses in the wheel, and that the angles shall always remain equal*; the arrangement to produce these properties is this: At the points $v\,v\,v\,v$ on the horse-beams, are firmly attached the wood or iron pulley cases, each having two small pulleys moving horizontally; and at the points $w\,w\,w\,w$, four other cases, each having a pulley moving horizontally, and likewise one vertically; each of these last with its pulleys, being suspended on a slide-rod of 2 feet in length. At each of the points v a loop of the ring-chain is passed through the case betwixt the two pulleys, and is drawn forward till it pass over the horizontal pulley at w. The *draught-chains* are now passed each through its own *vertical* pulley in the case w, the ends being carried forward and over the leading pulleys at the head of the yoke-trees; they are then led down and passed through the draught-pulleys in $q\,q$, the chains terminating at $c'\,d'$, to which the horses are yoked. The reeving of the pulleys and chains will be more clearly seen in the perspective views, fig. 335, a and b, where the same letters as before are applied. Thus, fig. 335, a shews the pulleys and case, as fixed to the horse-beam at v, with a part of the beam broken off at both ends, c', d' being parts of two sides of the square formed by the chain, and the double portion v' that part of the loop that would join w in fig. 335, b; here the loop passes round the horizontal pulley of w, and the portion of chain a', b' in this figure is the loop of the draught chain passing round the vertical pulley of w, and onward to the yoke-trees. In the same figure, y is the slide-rod, and x the hook by which the pulley-case is suspended and slides upon y.

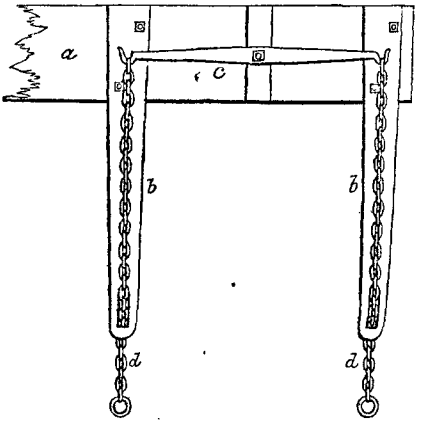
(1847.) It will be perceived that in this arrangement the primary figure of the chain cannot change, for though one horse pull so much as to go a-head an inch or a foot, some other horse, or perhaps the whole, must have retired in proportion, but the whole effect will be simply to lengthen or shorten these loops, without affecting the fundamental figure; every horse must, therefore, continue to pull an equal portion of the load, without change, unless any one is allowed to bring his pulley w to the end of the slide-rod, a circumstance that can hardly occur. In the usual methods of yoking upon a ring-chain the chain is only passed over the pulleys v, and the horse draws by the pulley, which in these arrangements is movable, the loop of the draught-chain, if double, passing round

* Prize Essays of the Highland and Agricultural Society, vol. xii. p. 264.

it, or if single, is simply hooked to the pulley-case; hence, the primary figure is variable; and suppose that one horse, or two opposite horses, were to slacken their exertions for a few seconds, and a lazy horse will be always disposed to do this, the two other horses must go ahead to tighten the chain, and these motions will produce a figure in the primary chain, having two acute and two obtuse angles, the lazy horses having the obtuse, and the willing horses the acute angles. It were easy to demonstrate, by the resolution of forces, that the two lazy horses, so long as they continued to pull lightly, would have much less exertion demanded of them to keep the chains in equilibrium than the other two horses, and the forces could only be restored to equality when the angles of the primary figure became again equal. This defect of the old methods of yoking upon this *catenarian system* does not appear to have attracted the attention of any enquirer, but the defects, without knowing why, seem to have deterred practical men from employing it, for it is now seldom seen in use; but Mr Christie's method, from the perfection of its principles, is deserving of application.

(1848.) A method of equalizing the resistance to the shoulders of each individual horse has been long practised, and which, from its simplicity as well as its beneficial effects upon the horses, is deserving of general adoption. The apparatus consists of an iron lever with equal arms, about 30 inches in length and 2 inches by $\frac{1}{2}$ inch at the centre; this is suspended upon a bolt by a perforation through the centre of the lever forming the fulcrum, and the ends are formed into hooks to which the draft chains are attached. Fig. 341 represents the application of this to the horse-beam, wherein *a* is a part of the beam and *b b* the yoke-trees; *c* is the lever above described, suspended upon the back of the horse-beam, *d d* the draught-chains, hooked to the lever, and passed under the pulleys of the yoke-trees, beyond which the horse is yoked to the extremity of the chains. The advantages of this mode of yoking will at once be obvious; for suppose, that, from inadvertence, the horse may have been unequally yoked; whenever he exerts his force, the chain that had been yoked short—suppose it to be the left shoulder—will immediately pull down the end of the lever to which it is hooked, and so bring the longer chain to bear with equal resistance upon the right shoulder. It will be found also, that the lever will vibrate at every step taken by the horse, as his efforts are changed at every step from the one shoulder to the other; the lever will therefore tend to equalize his exertions in respect to his muscular economy, and to the motion of the machine.

Fig. 341.



THE LEVER FOR EQUALIZING DRAUGHT.

(1849.) *The Water-wheel.*—Water, when it can be commanded, is the cheapest and most uniform of all powers; and on many farms it might be commanded by carefully collecting and storing in a dam. Water-wheels have been com-

monly treated as of two kinds, but, with great deference, I conceive they may be classed under two heads. The *under-shot*, or *open float-board* wheel, which can only be advantageously employed where the supply of water is considerable and the fall low; it can therefore rarely answer for farm purposes, and need not be discussed. The second is the *bucket*-wheel, which may be *over-shot* or *breast*, according to the height of the fall. It is this wheel that is adopted in all cases where water is scarce or valuable, and the fall amounting to 6 or 7 feet or more, though it is sometimes employed with even less fall than 6 feet. It is the most effective mode of employing water, except where the fall is excessively high, or exceeding 50 feet, when, in such cases, it is applied to motive machines that will rarely be employed for agricultural purposes, such as Barker's mill, &c.

(1850.) When it is proposed to employ a stream of water for the purpose of power, the first step is to determine the *quantity delivered by the stream in a given time;* this, if the stream is not large, is easily accomplished by an actual measurement of the discharge, and is done by damming up the stream to a small height, say 1 or 2 feet, giving time to collect, so as to send the full discharge through a shoot, from which it is received into a vessel of any known capacity, the precise time that is required to fill it being carefully noted. This will give a correct measure of the water that could be delivered constantly for any purpose; if in too small a quantity to be serviceable at all times, the result may found a calculation of the time required to fill a dam of such dimensions as might serve to drive a thrashing-machine for any required number of hours. If the discharge of the stream is more than could be received into any moderately-sized vessel, a near approximation may be made to the amount of discharge by the following method: Select a part of its course, where the bottom and sides are tolerably even, for a distance of 50 or 100 feet; ascertain the velocity with which it runs through this space, or any measured portion of it, by floating light substances on its surface, noting the time required for the substance to pass over the length of the space. A section of the stream is then to be taken, to determine the number of superficial feet or inches of sectional area that is flowing along the channel, and this, multiplied into five-sixths of the velocity of the stream, will give a tolerable approximation to the true quantity of discharge; $\frac{5}{6}$ of the surface velocity, at the middle of the stream, being very nearly the mean velocity of the entire section. Suppose the substance floated upon the surface of the stream passed over a distance of 100 feet in 20 seconds, and that the stream is 3 feet broad, with an average depth of 4 inches, here the area of the section is exactly one foot, and the velocity being 100 feet in 20 seconds, gives 300 feet per minute, less $\frac{1}{6}$ = 250 feet, and this, multiplied by the sectional area in feet or 1 foot, is 250 cubic feet per minute for the discharge. It is to be kept in mind that this is only an approximation, but it is simple, and from repeated experiments I have found it to come near the truth. For those who wish to go more elaborately into the subject, I may here state a formula derived from those of Sir John Leslie, for finding the mean velocity, and, having also the transverse section, to find the discharge of a stream or river.

Multiply the *constant* 1.6 into the hydraulic depth and into the slope of the surface of the water per mile, the square root of the product will give the *mean velocity* of the stream in feet, per second; and the root, multiplied by the section of the stream in square feet, is the discharge per second. The *hydraulic depth* is the transverse section of the stream

in square feet, divided by the periphery of the stream, less the surface breadth.

Example—If the surface breadth be 3 feet, the bottom breadth $2\frac{1}{2}$ feet, and the slope of the sides each 9 inches, a transverse section of these dimensions will contain 2 square feet nearly, which, divided by the periphery, which is

$$3 + .75 + .75 + 2.5 = 7, \text{ the periphery,}$$

then the area of the section $= 2$ feet;

$$\text{put } 2 \div (7 - 3) = .5 = 6 \text{ inches, the hydraulic depth.}$$

And suppose the slope at the place of section to be $1\frac{1}{2}$ inch on 100 feet, or 6.5 feet per mile, apply the formula—

$$\sqrt{1.6 \times .5 \times 6.5} = 2.3 \text{ feet, the velocity per second, nearly,}$$

and the delivery will be $2.3 \times 2 \times 60 = 276$ cubic feet per minute.

(1851.) The next step is to ascertain by levelling, from the most convenient point at which the stream can be taken off, to the site where the water-wheel can be set down, and to that point in the continuation of the stream where the water can be discharged from the wheel, or what is called the outfall of the tail-race. If the water has to be conveyed to any considerable distance from the point where it is diverted from the stream to the wheel, a lead must be formed for it which should have a fall of not less than $1\frac{1}{2}$ inches in 100 feet, and this is to be deducted from the entire fall. Suppose, after this deduction, the clear fall to be 12 feet, and that the water is to be received on a bucket-wheel whose power shall be equal to four horses.

The rule for finding the power due to a stream of water, whose discharge is already known is, multiply the discharge in cubic feet, per minute, by the height of the fall, and again by 62.5—the lbs. weight of a cubic foot of water—dividing by 44,000, gives the number of horse power.

In the present case, having the height of the fall given and the power wanted, we have the question in this form,

$$\frac{44{,}000 \times 4}{62.5 \times 12} = 234 \text{ cubic feet,}$$

the quantity of water required per minute to produce four horses' power.

If the stream does not produce this quantity, a dam must be formed by embanking or otherwise, to contain such quantity as will supply the wheel for three or six hours, or such period as may be thought necessary. The quantity required for the wheel here supposed, for three hours, would be 42,120 cubic feet; but suppose the stream to supply one-fourth part of this, the remainder, or 31,590 feet, must be provided for in a dam, which, to contain this, at a depth not exceeding 4 feet, would be 88 feet square. But the constant supply of water is often much smaller than here supposed, and in such cases the dam must be proportionally large.

(1852.) The *dam* may be formed either upon the course of the stream, by a stone-weir thrown across it, and proper sluices formed at one side to lead off the water when required, or, what is much better, the stream may be diverted from its course by a low weir into an intermediate dam, which may be formed

by digging and embankments of earth, furnished with sluice and waste-weir, and from this the lead to the wheel would be formed. The small weir on the stream, while it served to divert the water, when required, through a sluice to the dam, would in time of floods pass the water over the weir, the regulating sluice being shut to prevent flooding the dam. This last method of forming the dam is generally the most economical and convenient, besides avoiding the risk which attends a heavy weir upon a stream that may be subject to floods. When water is collected from drains or springs, it is received into a dam formed in any convenient situation, and which must also be furnished with a waste weir, to pass off flood waters, besides the ordinary sluice.

(1853.) The water-wheel should be on the *bucket* principle, and, for a fall such as we have supposed, should not be less than 14 feet diameter; the water, therefore, would be received on the breast of the wheel. Its circumference, with a diameter of 14 feet, will be $3.1416 \times 14 = 44$ feet; its velocity, at 5 feet per second, is $44 \times 5 = 220$ feet a minute; and 234 cubic feet, per minute (1851.), of water spread over this, gives a sectional area for the water laid upon the wheel of $\frac{234}{220} = 1.06$ feet; but as the buckets should not be more than half filled, this area is to be doubled $= 2.12$ feet; and as the breadth of the wheel may be restricted to 3 feet, then $\frac{2.12}{3} = .704$ foot, the depth of the shrouding, equal to $8\frac{1}{2}$ inches nearly, and if the wheel is to have wooden soleing, 1 inch should be added to this depth already found, making $9\frac{1}{2}$ inches.

(1854.) The *arc or race*, figs. 342, 343, Plate XXV, in which the wheel is to be placed must have a width sufficient to receive the wheel with the toothed segments attached to the side of the shrouding. For a bucket-wheel it is not necessary that it be built in the arc of a circle, but simply a square chamber; one side of it being formed by the wall of the barn, the other by a wall of solid masonry, at least $2\frac{1}{2}$ feet thick; one end also is built up solid, while the opposite end, towards the tail-race, is either left entirely open, or if the water is to be carried away by a tunnel, the water-way is arched over and the space above levelled in with earth. It is requisite that the wheel-race here described, should be built of square-dressed stone, not common ashler, but having a breadth of bed not less than 12 inches, laid flush in mortar, and pointed with Roman cement. In fig. 342, the plan, a' is the wall of the barn, b' the outward wall, and c' the end; a recess d' being formed in the wall a', for the bearing of the water-wheel shaft. Fig. 343 shews the section; a' as before is the barn-wall, b' is the sole of the arc or chamber, formed of solid ashler-stone, having an increased slope immediately under the wheel, to clear it speedily of water.

(1855.) Plate XXV., figs. 342 and 343, exhibit a *plan* and *sectional elevation* of the wheel, with the same letters of reference in each, and represented of dimensions agreeing to the supposed case (1853.); fig. 343 representing one half of the wheel or section, the other in elevation. The shaft, the arms, and shrouding, are all of cast-iron, the buckets and sole being of wood, and to prevent risk of fracture, the arms are cast separate from the shrouding. The width of the wheel being 3 feet, the toothed segments 4 inches broad, and they being 1 inch clear of the shrouding, gives a breadth over all of 3 feet 5 inches, and, when in the race, there should be at least 1 inch of clear space on each side, free of the walls. The shaft a is not required to be longer than just to pass through

the bearings, for in wheels of this kind it is improper to take any motion directly from the shaft. The eye-flanges *b*, 2 feet diameter, are separate castings, to which the arms *c* are bolted; the flanges being first keyed firmly upon the shaft. The shrouding *d d* is cast in segments, and bolted to the arms and to each other at their joinings. On the inside of the shroud-plates are formed the grooves for securing the ends of the buckets and of the sole-boarding, in the form as shewn in the section from *e* to *e*. The form of the buckets should be such as to afford the greatest possible space for water, at the greatest possible distance from the centre of the wheel, with sufficient space for the entrance of the water and displacement of the air. In discharging the water from the wheel also, the buckets should retain the water to the lowest possible point. These conditions are attained by making the pitch *f f* of the buckets, or their distance from lip to lip, $1\frac{1}{2}$ times the depth of the shrouding; the depth of the front of the bucket *f g* inside, equal to the pitch; and the breadth of the bottom *g h* as great as can be attained consistently with free access of the water to the bucket immediately preceding; this breadth, inside, should not exceed $\frac{2}{3}$ of the depth of the shrouding.

(1856.) The *shrouding plates* are bolted upon the buckets and soling by bolts passing from side to side; and in order to prevent resiliance in the wheel, the arms are supported with diagonal braces. The toothed segments *i* are bolted to the side of the shrouding through palms cast upon them for that purpose, and the true position of these segments requires that their pitch lines should coincide with the circle of gyration of the wheel; when so placed, the resistance to the wheel's action is made to bear upon its parts, without any undue tendency to cross strains. For that reason it is improper to place the pitch line beyond the circle of gyration, which is frequently done, even upon the periphery of the water-wheel. The determination of the true place of the circle of gyration is too abstruse to be introduced here; nor is it necessary to be so minute in the small wheels to which our attention is chiefly directed; suffice it for the present purpose to state, that the pitch line of the segment wheel should fall between $\frac{1}{2}$ and $\frac{2}{3}$ of the breadth of the shrouding, from the extreme edge of the wheel.

(1857.) Another important point is that *where the power is taken off from the wheel*, that is, the placing of the pinion *k*. The most advantageous part for placing this pinion is in a line horizontal to the axis of the water-wheel; here the whole weight of the water acts in impelling the pinion, while no strain is brought on the shaft beyond the natural weight of the wheel. In every position *above* this, unnecessary strains are brought upon the shaft and other parts of the wheel, and these increase with the distance from the first point *k*, till, if placed at the opposite point horizontal to the axis, the load upon the shaft would be *double* the weight of all the water upon the wheel, over and above the weight of the wheel itself.

(1858.) *Laying the water upon the wheel* is another point of some consequence; but whether it be delivered over the crown of the wheel, or at any point below that, the water should be allowed to fall through such a space as will give it a velocity equal to that of the periphery of the wheel when in full work. Thus, if the wheel move at the rate of 5 feet per second, the water must fall upon it through a space of not less than .4 foot; for, by the laws of falling bodies, the velocities acquired are as the times and whole spaces fallen through, as the squares of the time. Thus the velocity acquired in 1″ being 32 feet, a velocity of 5 feet

will be acquired by falling .156″; for 32 : 1″ :: 5 : .156″, and $1''^2 : 16 :: .156''^2 : .4$ foot, the fall to produce a velocity of 5 feet. But this being the minimum, the fall from the trough to the wheel may be made double this result, or about 10 inches. The trough which delivers the water upon the wheel should be at least 6 inches less in breadth than the wheel, to give space for the air escaping from the buckets, and to prevent the water dashing over at the sides; *l* is the trough and *m* the spout that conveys the water to the wheel. It is convenient to have a regulating sluice *n*, that serves to give more or less water to the wheel; and this is worked by a small shaft passing to the inside of the barn. The shaft carries a pinion *q*, working the rack of sluice-stem *r*, a small friction-roller *s* being placed in proper bearings on the crosshead *t* of sluice-frame; and this apparatus is worked inside the barn by means of a lever handle upon the shaft of the pinion *q*. As a waste-sluice, the most convenient and simple, in a mill of this kind, is the trap-sluice *o*, which is simply a board hinged in the sole of the trough, and opening from the wheel; it is made to shut close down to the level of the sole, and when so shut, the water passes freely over it to the wheel. The lifting of this sluice is effected by means of the connecting-rod *u* and crank-lever *v*, the latter being fixed upon another small shaft, which passes through the wall to the interior of the barn, where it is worked in the same manner as the former. When it is found necessary to set the wheel, the trap is lifted, and the whole supply of water falls through the shoot *o p*, leading it to the bottom of the wheel-race, by which it runs off, until the sluice at the dam can be shut, which stops further supply. The wheel here described, if it moves at the rate of 5 feet per second, will make $6\frac{3}{4}$ revolutions per minute. The pinion-shaft *w* will carry a spur-wheel at *x*, by which all the other parts of the machine can be put in motion as before. The rate of the spur-wheel at *x* depends on the relation of the water-wheel and its pinion. In the present case they are in the proportion of 8 to 1, and, as the water-wheel makes $6\frac{3}{4}$ revolutions per minute, this multiplied by 8, will give 54 to the spur-wheel.

(1859.) Having now considered the thrashing-machine, and the different kinds of power usually applied to it, it might be desirable to take notice of that form of the machine which is worked *by hand*. There are, however, so few successful examples of it, and its advantages being somewhat doubtful, it appears unnecessary to enter upon it in this place.

(1860.) There is one diminutive form, however, that merits notice,—a *one-horse machine*. In some of our pastoral districts, where the proportion of arable land is so small as not to warrant the expense of a large thrashing-machine, these have been very successfully adopted. They are constructed with a small horse-wheel, generally over-head; and the motion is carried into the barn in the usual form, where a spur-wheel drives the drum-pinion at a velocity of 250 turns per minute. The drum is 27 inches long and 30 inches diameter over the beaters; it strikes downward, and has a pair of feeding-rollers. There is neither shaker nor fan attached to the machine, and four people are required to carry on the process, the dressing being an after operation. With this little machine 12 bushels of oats can be thrashed in an hour; and the whole cost of it is about L.20.

(1861.) There remains to be noticed one more member of this family of machines,—the English *portable thrashing-machine*. It is now most extensively employed in the southern parts of the kingdom, and apparently to good purpose. But while I grant this to the machine, I must demur to the practice which involves out-of-door thrashing, and a system of half-performed work. But it is

to the machine, and to one member of it alone, that I wish to direct attention, namely, the *drum*. It appears to me, in regard to this member, that the English and the Scotch machines operate on different principles. In the latter, as is well known, the thrashing is performed by a process of beating, and the instrument acts over but a short space, upon the grain undergoing the process, that is, while it is under the drum-cover, or about one-fourth the circumference of the drum-case; and even during a part of this progress, the cover is so distant from the beaters—about 3 inches—that little effect is produced upon the straw beyond a few inches from the feeding-rollers. There can be no doubt that, owing to this peculiar construction, when a stray ear of corn, or a sheaf-band, happens to enter root foremost, they are very likely to pass unthrashed, for the rollers have no hold of them; and they are so lightly pressed upon the beaters that we cannot be surprised at their passing in an imperfectly thrashed state. It has come under my observation, also, that, taking our machines as usually worked, and applying them to the thrashing of corn cut by the scythe, the work, from the same cause, is often imperfectly performed, mainly in consequence of many of the ears entering by the reverse end. Of late years, many attempts have been made to improve our thrashing-machines, by improving the shaking apparatus, apparently forgetting that the shaker should have nothing to do beyond separating loose grains from the straw. The duty of the shaker is not to thrash; and when foul thrashing appears, it is the drum, not the shakers, that are in fault.

(1862.) Let us turn to the English machine, which has nothing, it is true, beyond a drum and feeding-rollers, and they even—the follers—can be left out, The drum, or, as I would call it, the *rubber*, though armed with what may be called beaters, does not, in fact, thrash by beating, but by rubbing the grain against a wire grating, and in this lies its best qualities. The drum of this machine is a skeleton formed of two rings of cast-iron, similar to fig. 331 (1780.), fixed upon an axle, and to these rings are fixed six beaters, lying parallel to the axle, forming a skeleton cylinder. Its diameter never exceeds 24 inches, often as low as 20 inches, and its length from 24 to 30 inches. It revolves within a concave, which embraces nearly three-fourths of its circumference, and is nowhere more distant from the beaters than $1\frac{1}{4}$ inch. The concave is nearly throughout an open trellis or grating, composed of plates and rods of iron and wire; and to complete all, this drum makes from 600 to 800 revolutions per minute. In an apparatus of this kind, it is impossible that an ear of corn, enter how it may, can escape unthrashed, or rather rubbed; for it will be evident, I think, from the description, that the machine operates by a process of *rubbing* out the grain. And, with all the defects that attend these machines, it must be granted to them that they thrash clean.

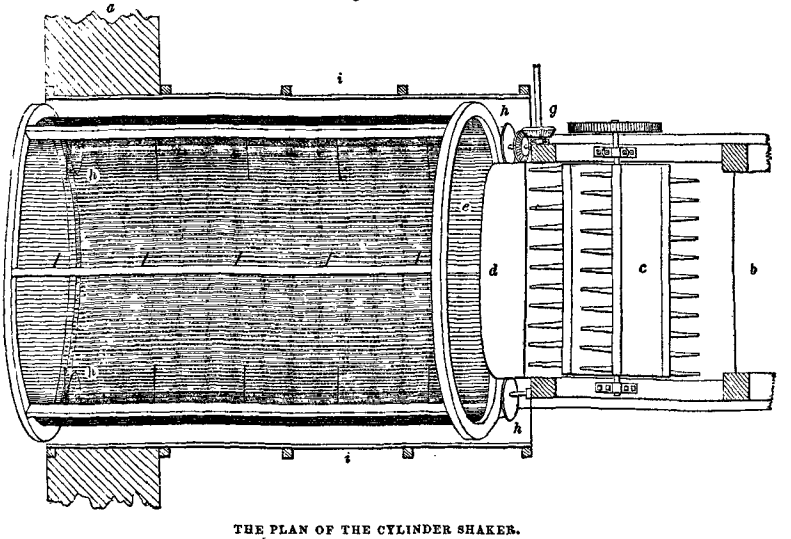
(1863.) Contrasting these machines, we see the Scotch one operating with a very heavy, and, from its general construction, sluggish cylinder, its beaters moving with a velocity of less than 3000 feet a minute, and the grain subjected to its influence over a space not exceeding $1\frac{1}{2}$ foot; and when worked by 4 horses, thrashing at the rate of 26 bushels of wheat per hour, dressing included. In the English machine is to be seen a small and extremely light skeleton cylinder, which, from its structure, must be easily moved, though its beaters move with a velocity of 4000 feet per minute, and the grain subjected to its influence over a space of about 4 feet, and, when worked by 4 horses, thrashing at the rate of 36 bushels of wheat per hour, but not dressed, though in general very clean

thrashed. The straw is perhaps a little more broken, which is sometimes unimportant.

(1864.) I cannot view these two machines without feeling impressed with a conviction that both countries would soon feel the advantage of an amalgamation between the two forms of the machine. The drum of the Scotch thrashing-machine would most certainly be improved by a transfusion from the principles of the English machine; and the latter might be equally improved by the adoption of the manufacturing-like arrangements and general economy of the Scotch system of thrashing. That such interchange will ere long take place, I am thoroughly convinced; and as I am alike satisfied that the advantages would be mutual, it is to be hoped that these views will not stand alone. It has not been lost sight of, that each machine may be said to be suited to the system to which it belongs, and that here, where the corn is cut by the sickle, the machine is adapted to that; while the same may be said of the other, where cutting by the scythe is so much practised. Notwithstanding all this, there appears to be good properties in both that either seems to stand in need of.

(1865.) Amongst the various attempts at the *improvement of the shaking process* in the thrashing-machine, we have to notice that introduced by Mr Ainslie, Peaston, consisting of a large cylindrical screen, open at both ends, placed at an angle of 18°, and in that position made to revolve 18 times a minute. Fig. 344 is a bird's-eye plan, and fig. 345 a longitudinal section, of this shaker and connecting apparatus, the same letters being applied in both figures to mark the corresponding parts. *a a* is the wall separating the thrashing from the straw-barn; *b* the place of the drum in the common machine; *c* is a rake-shaker of about 4 feet diameter, applied in the usual manner, and it throws the straw over

Fig. 344.

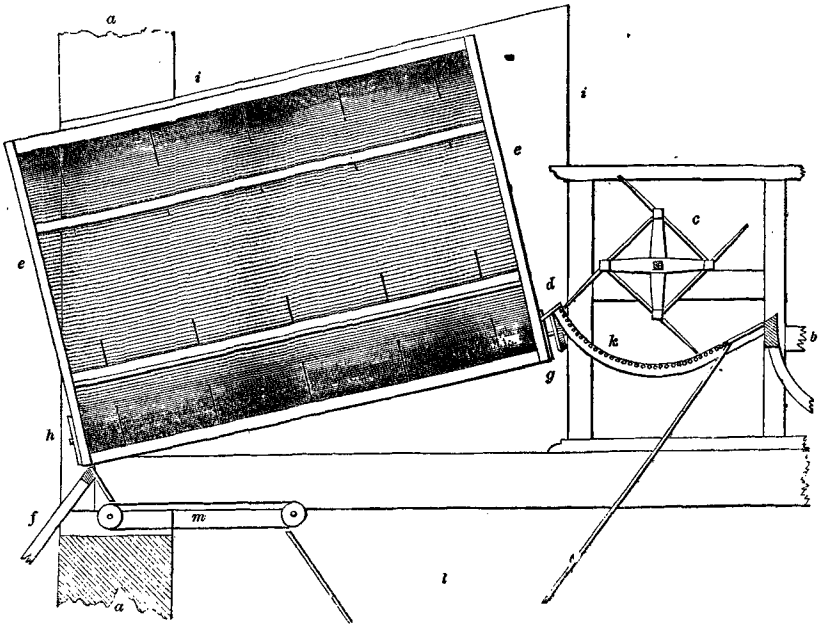


THE PLAN OF THE CYLINDER SHAKER.

the apron *d* into the cylinder *e e*, which, in its revolution, carries the straw repeatedly to the top, from whence it falls, to be again lifted, until it is discharged at the

lower end upon the common screen *f*. The cylinder is put in motion by means

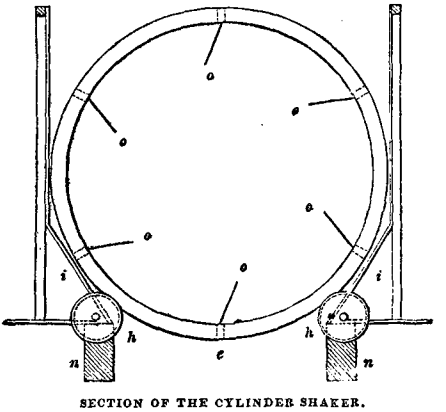
Fig. 345.



THE ELEVATION OF THE CYLINDER SHAKER.

of the mitre-wheels *g* driving a sloping shaft on each side of the cylinder; these carry a flanged pulley at each end *h h h h*, and the cylinder, resting upon these, is carried round by simple contact; *i i* is the casing of the shaker; *k* the screen of the rake-shaker, and *l* the great hopper, of the usual construction, *m* being an endless web to convey the grain that falls through the lower parts of the cylinder into the hopper. Fig. 347 is a transverse section of the cylinder; *n n* are the ends of the foundation beams, *e* the cylinder, *h h* the pulleys, *i i* the casing, and *o o*, &c. are rows of spikes that carry up the straw, to be let fall on reaching the top. The cylinder is usually made 9 feet in length, and 7 feet in diameter, of light frame-work, and is lined all over internally with wire trellis-work $\frac{3}{4}$ inch square in the mesh. For a more

Fig. 346.



SECTION OF THE CYLINDER SHAKER.

detailed description of this shaker, the reader is referred to the Prize Essays of the Highland and Agricultural Society, vol. xiii. p. 491.

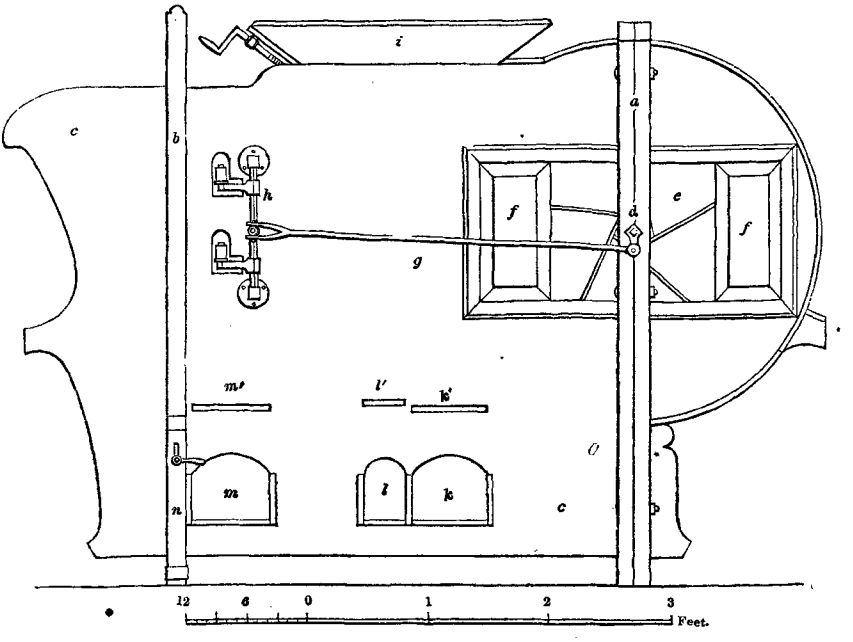
(1866.) *Barn fanners.*—The fanners referred to in (1793.) is the common winnowing-machine or fanners, and is here represented in figs. 347, 348, and 349. The first is an *elevation*, to which is attached a scale of feet for the three figures; the second a *longitudinal section;* and the third a *transverse section*. These figures exhibit in detail a fanner that is considered to be of the most approved construction, both for cleaning and separating the various qualities of grain. The principle on which the blast of the fanner is produced being so well known, it appears unnecessary to do more than merely to say, that it is produced by the quick revolution of a light four or five vaned fan within a case, the air being inhaled through central openings in the sides of the case, and discharged with considerable force by a lateral opening in the curved side of the case, through which it is discharged upon the grain as it falls from a hopper. The grain thus subjected to the effects of a strong current of air undergoes a mechanical separation and distribution; and in this machine these separations extend to five divisions: 1. the sound and best grain; 2. an inferior quality in respect of individual bulk of the grains; 3. extraneous small seeds; 4. light grain, and grain with husks attached; and, 5. the chaff. These separations go on simultaneously, and the proceeds of the different divisions are each collected separately.

(1867.) The machine, in its dimensions, measures 6 feet 9 inches in extreme length, 4 feet 9 inches in height, and in breadth 1 foot 9 inches. In the elevation, fig. 348, the following parts are exhibited. The frame-work, formed usually of hard-wood, consists of the principal frame *a*, which is usually made double, or in halves, for the convenience of removing the outward half of the fan-case, and of the back-frame *b*. The distance at which these frames are placed apart is 3 feet 8 inches, and the axle of the fan has its bushes in the line that joins the principal frame. The side-boarding *c c* is of $\frac{3}{4}$-inch deal: in laying it out, the centre of the fan *d* is 3 feet from the bottom, and the radius of the fan is 1 foot 6 inches. The air-ports *e* are furnished with the sliding pannels *f f*, by which the admission of the air, and ultimately the force of the blast, can be regulated. The crank *d* has a radius of $1\frac{1}{2}$ inches; and the connecting-rod *g* communicates motion to the double or bell-crank spindle *h*, whose office it is to move the riddle-frame. The hopper *i* receives the rough grain, and the spouts *k*, *l*, *m*, deliver respectively the first, the seconds, and the light grains, after separation in the machine; but, as it would be inconvenient to deliver these all at one side, there are corresponding sliders *k'*, *l'*, *m'*; and each side being provided with spouts and sliders, the latter are shifted so as to cause the three qualities to be delivered, two on one side, and the third on the opposite side. The slot-bar *n* is for the purpose of adjusting the length of the fourth foot of the machine to any inequalities of the barn floor.

(1868.) Fig. 348 is the longitudinal section, where *a a* is the main frame, *b b* the back frame, and *c c* the side boarding; *d* is the fan with its five vanes, and *e* the air-port. The fans revolve within the circular case *f g h*, the space *f g* being open for the discharge of the air; the position of the point *f* is determined by taking the chord of an arc *h i* = 12 inches, and *h f* a tangent to the curve at the point *h*. Then, with a horizontal distance of 15 inches from the diameter *a i*, cut the tangent in the point *f*, and drawing *f k* parallel to *a i*, and the position of a side of the spout *k*, fig. 348, is given. The width of the

spout *k* is 7½ inches, that of *l*, 4 inches, and of *m* likewise 7½ inches, leaving the intermediate space 8 inches. The opening *f g* in the case for the discharge of the blast is 20 inches ; and the funnel-board *g o*, 9 inches in breadth, is so placed that, if produced, it would meet the tangent *h f*, when also produced,

Fig. 347.

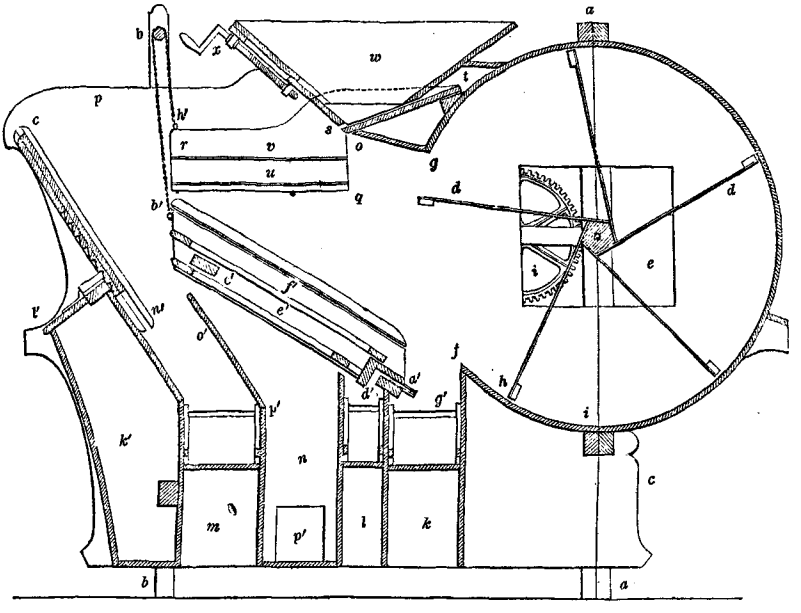


THE ELEVATION OF DRESSING FANNERS, WITH RIDDLES AND SIEVES.

in the line of the upper edge of the side-boarding at a point *p*. The shoe and riddle-frame, of which *o q r s t* is one of the sides, has the shoe *s t*, 13 inches in breadth, nailed upon the under edges of the two sides, sloping at an angle of about 18°, while that part of the sides that form the riddle-frame lies horizontally, and is 6½ inches in depth. It receives two riddles, slid into the grooves *u* and *v*, and the entire frame plays horizontally on a pivot in *t*. The hopper *w* is 28 inches square at the top-edges, the sides sloping inward to 9 inches in width and 7½ inches in length, where it meets the shoe, and is fitted so as just to let the shoe vibrate freely below it. A sluice *o* is fitted to the front of the hopper, and moved by the screw-winch *x* to regulate the feed. The sieve-frame *a' b'* is 28 inches in length and 5 inches in depth ; the two sides are connected by the bars *c'* and *d'* at a width of 15 inches over all, being the same breadth as the riddle-frame. This frame is also provided with two sets of grooves *e'* and *f'*, which receive the sieves; and the frame is supported in front on a pivot at *a'*, or, as in most cases, it is produced to *g'*. Both frames are supported behind by the chains *b'* and *h'*, attached to the stretcher-rod *b*. The toothed wheel *i'*, seen in part through the air-port, is turned by the winch-handle *k*, seen in fig. 349,

and acts upon a pinion fixed upon the axle of the fan. The proportions of the wheel and pinion are $4\frac{1}{2}$ to 1, the fan making from 212 to 220 revolutions per minute. The space k' is a locker in which the spare riddles are kept, l' being a

Fig. 348.



THE LONGITUDINAL SECTION OF THE FANNERS.

lid that opens into it; $c\,n'$ is a slider that can be raised or depressed to catch the light grain, while it allows the chaff to pass over. The sieve-frame $a'b'$ is furnished with two wire-cloth sieves; the upper one has 9 meshes in the inch, the lower 7 meshes.

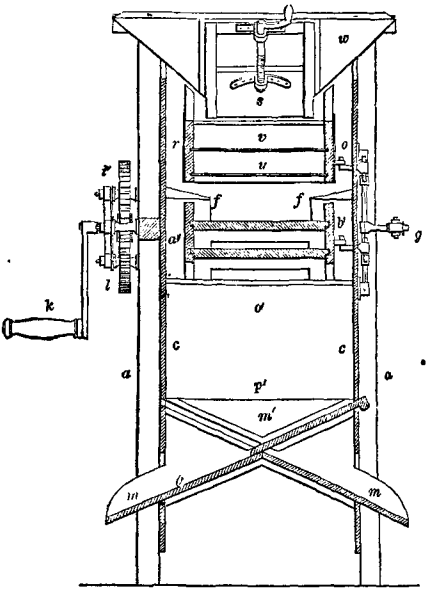
(1869.) The full complement of riddles for the riddle-frame is six, of which two only can be employed at one time. Their meshes are, for wheat 5 in the inch, for barley 4 in the inch, and for oats 3 in the inch. The slap-riddles are $\frac{3}{4}$ inch, and 1 inch in the meshes.

(1870.) Fig. 349 is the transverse section; $a\,a$ the frames, $c\,c$ the side-boarding; $m\,m$ are the light spouts, corresponding to m of figs. 347 and 348; m' are the sliders to change the direction of the discharge; and $o'p$ is the sloping division $o'p'$ of fig. 348. The sieve-frame, with its two sieves, are contained between a' and b'; and $f\,f$ are two flaunch-boards, sloping over the sieve-frame, to direct the grain upon the sieve. The riddle-frame, with its riddles u and v, are contained between r and o; and w is the hopper, with it sluice s. The end of the connecting-rod g, fig. 348, is seen at g, as jointed to the bell-cranks that shake the riddles and sieves by their attachment at b' and o; i' is the toothed wheel, with its winch-handle k, and framework l, by which the fan is impelled.

(1871.) When these fanners are in operation (see fig. 348), the blast is sent through the tunnel $f\,g\,o\,b'$. Its chief force is directed upon that end of

the riddles *q o*; and as the grain falls from the hopper upon that end of the riddles, the lighter chaff is immediately blown off beyond the point *c*. The remainder, with the grain, will be passing through the riddles towards the sieve; and during this stage, any remains of chaff are blown off, and the light grain and seeds are blown beyond *b'*. The blast not having power to carry them over *c*, they fall down between *c* and *b'*, and are discharged at the *lights* spout *m*, fig. 347; at the same time, the heavy grain and seeds fall upon the upper sieve *f'*, when all the plump full-sized grains roll down over this sieve, and are delivered at the *first* spout *k*, fig. 347. These grains, together with other seeds, whose specific gravity exceeded the *lights*, but whose bulk, being under that which the upper sieve is intended to pass, they consequently fall through the meshes, and are received upon the lower sieve *e'*; upon this the grain so received rolls down and is delivered through a small opening at the foot of the sieve *e'* into the chamber of the *seconds* spout *l*, fig. 347. The smaller seeds, such as those of *sinapis* and others, being too small to be retained even upon this sieve, fall through it, and are received into the chamber *n*, from which they are removed at convenience through the aperture *p'*, which is closed by a sliding shutter. The usual price of this fanner, with its riddles and sieves, is L.9, 9s.

Fig. 349.

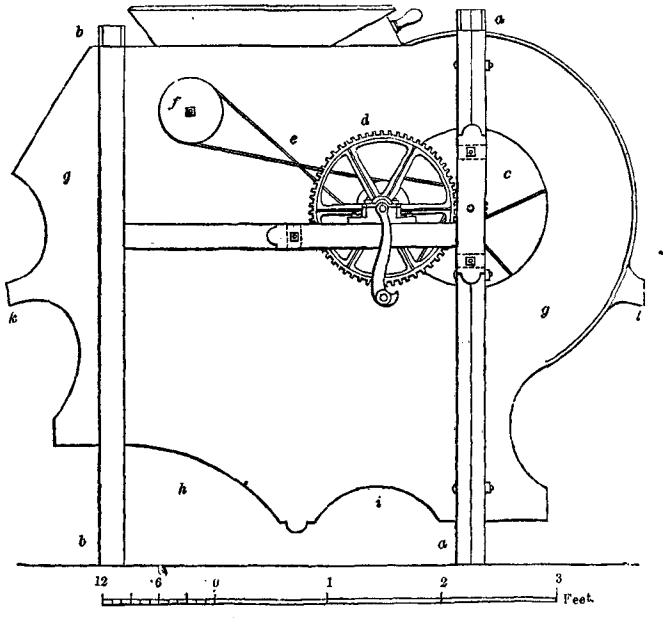


THE TRANSVERSE SECTION OF THE FANNERS.

(1872.) *The Finishing Fanners, or Duster.*—This is a fanner of simpler construction than the former. On many occasions it may take place of the former; and, from its lightness of working, may be always employed for giving the finish after hummelling, or when grain has lain any time in the granary. This, in regard to blast, is constructed on the same principle as the former; but, in its details, is much simplified. Fig. 350 is an *elevation*, in which the framework is similar to the last, but its over-all dimensions are smaller, the extreme length being 5 feet 8 inches, the height 4 feet 8 inches, and the width, as before, 1 foot 9 inches. The main frame *a a* is again made in halves, and the back frame *b* is placed at 3 feet from the first. The diameter of the fan is 3 feet, and of the air-port *c* 16 inches. The wheel *d*, and its pinion on the axle of the fan, are in the same proportion as before; but on the axle of the wheel, a pulley, of 5 inches diameter, is mounted, which, by means of a cross-belt *e*, drives the pulley *f*, of the same diameter as the first, and which is placed upon the axle of a feeding-roller. The side-boarding *g g* is formed to the taste of the maker, except in that part which forms the fan-case, and in the parts *h* and *i*, which are cut away to afford more ready access to the *lights*, and to

small seeds that may have been separated. *k* and *l* also are handles by which it may be lifted.

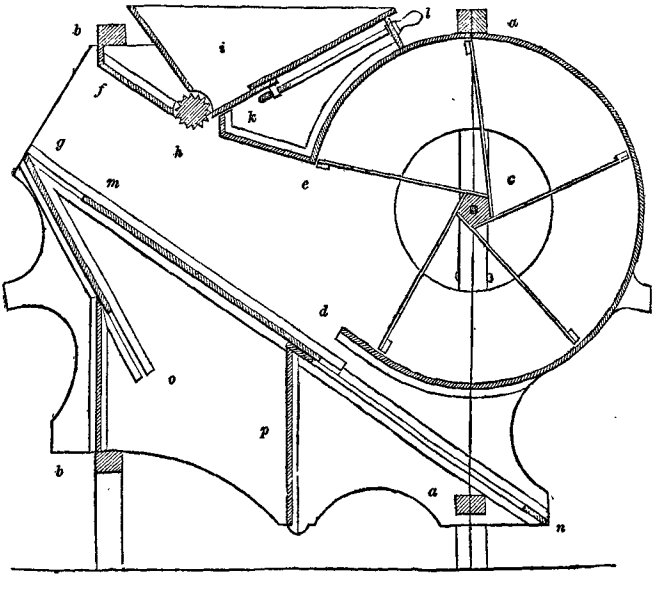
Fig. 350.



THE ELEVATION OF THE FINISHING FANNERS OR DUSTER.

(1873.) Fig. 351 is the *longitudinal section*, where, as before, *a a* and *b b*

Fig. 351.

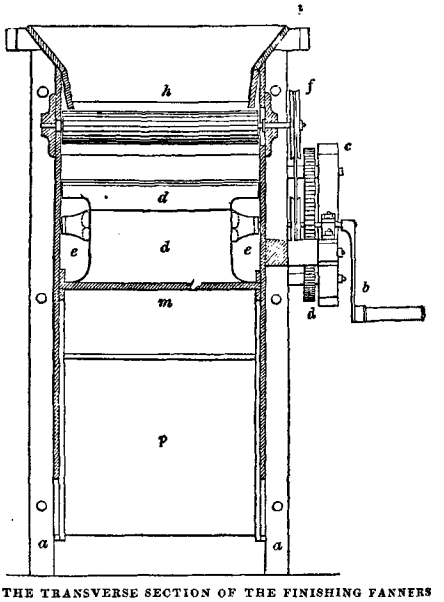


THE LONGITUDINAL SECTION OF THE FINISHING FANNERS.

are the cross rails of the frames, and *c* the air-port. In this machine, the blast is sent directly through an open tunnel; the opening *d e* being 17 inches, and *f g* 11 inches, the latter being continued outward from the feeding-roller *h*, which is so placed as not to offer any obstruction to the current. The hopper *i* is furnished with a slider *k*, which is adjusted to the requisite feed by the screw *l*; and the sole of the tunnel, from *m* to *d*, is a solid board, while the shoot from *d* to *n*—the point of discharge for the *firsts*—is a wire-sieve. The opening between the case *d* and the sole is 3¼ inches, and the slope is an angle of 35°. That part of the sole *m d*, and the board *g o*, are both fitted to slide up or down to temper the division of the *lights*, should any of them remain; and *p* is a division, separating the lights from the small seeds.

(1874.) Fig. 352 is the *transverse section*. *a a* are the frames, *b* is the winch handle, *c* the wheel-framing, and *d* the wheel; *f* is the pulley of the feeding-roller, *h* the roller, and *i* the hopper. Of the interior parts, *p* is the division under the sole, *m* is the sole as seen below, and *d d* are the vanes of the fan, *e e* being its axle.

Fig. 352.



THE TRANSVERSE SECTION OF THE FINISHING FANNERS OR DUSTER.

(1875.) In operating with this fanner, the grain is taken from the hopper by the revolution of the feeding-roller; and as it falls perpendicularly in a thin sheet, is intercepted by the blast under the most favourable circumstances. All such chaff and dust as yet remain amongst it, is blown over the backboard *g*, fig. 351; the light grain that may have remained is separated also, and falls between *g* and *m*, down the spout *g o*; the remainder runs down the sole *m d*, and in passing from *d* to *n*, should any small seeds yet remain, they are intercepted, and fall through the screen *d n*, while the *firsts* pass on, and are delivered at *n*. The price of this fanner is L.6, 15s.

(1876.) The *thrashing-machine fanners* differ so little in their essentials from the first described, that it appears unnecessary to give a figure of it. The width for a 6-horse-power machine ought to be considerably more than the common fanners, not under 24 inches, nor is it requisite that it should exceed 30 inches. The fan is of the same diameter, and the first spout stands in the same relation as described in fig. 348, but should be 20 inches distant from the vertical line passing through the centre of the fan, and 9 inches wide. There is no spout corresponding to the *seconds* of that figure; but the foul spout takes the place of the lights, and is 11 inches wide; the distance between them should be 22 inches. The riddles and sieves of fig. 348 are entirely left out, and in their place a simple shoe, of 2 feet 10 inches in length, with a sheet-iron bottom, which is

perforated all over in 1-inch holes at $\frac{5}{8}$ inch apart. This is placed under the great hopper, and is agitated by a connecting rod from a crank on the fan-axle, in the same manner as exhibited in fig. 347. The extreme length of the machine fanners should be 8 feet, and their height 4 feet 10 inches.

(1877.) Although variations in the construction of fanners are numerous, yet they are not such deviations from one general principle as to constitute essential distinctions. The fan is seldom, if ever, varied, except in breadth, and the riddles, though an appendage to the machine, do not, to any extent, alter its character; the chief difference, indeed, seems to lie more in dimensions than in any essential point. But when we consider the remarkable effects produced of late years by the application of the same principle to the raising of blast for important purposes in manufactures and the arts, through the discovery of the Messrs Carmichael, Dundee, who were the first to apply the fan-blast to forges and furnaces, for the working and smelting of metals; we are astonished by the powerful effects of small fans when driven at high velocities, and find reason to hope that the barn-fanners may yet undergo changes that will reduce its bulk greatly below any present standard.

(1878.) *The Hummeller.*—The hummelling of barley is a process that, in many cases, is essential to the marketable condition of that grain, and it is effected in many different ways. In some cases the thrashing-machine itself is made the hummeller, by employing a fluted cover to the drum; in others, without this addition, the barley is shut up in the drum-case for a few minutes while the drum is revolving, as recommended by the Rev. Dr Farquharson, Alford.* Another method is with a conical receiver, within which a spindle, carrying a number of cross arms, is made to revolve, and the grain passes through this machine, lying nearly in a horizontal position, before entering the fanners. This form of the hummeller was brought forward by Messrs Grant, Grantown, Banffshire,† and with some modifications,—which are, however, very important ones, and give a new character to the machine,—a hummeller similar to that is now the most approved form, the case being made cylindrical, and its position vertical. Instead, also, of the grain passing loosely through the cylinder, an essential characteristic of the improved machine is, that the cylinder shall be always full of grain.

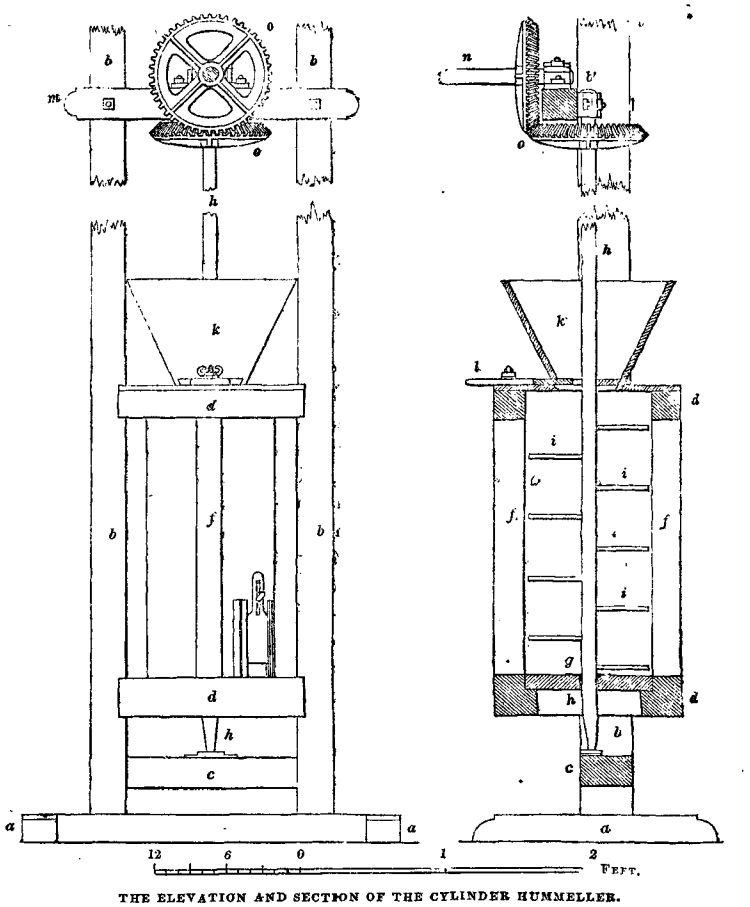
(1879.) The *cylinder hummeller* consists of a cylindrical case of wire-cloth, having an upright iron spindle revolving within it, armed with a number of flat thin blades of iron, kept in revolution at a high velocity. The grain is admitted through a hopper at top, keeping the cylinder always full, and is discharged through a small orifice at bottom, the degree of hummelling depending upon the area of this orifice. Fig. 353 is an elevation, fig. 354 a vertical section, and fig. 355 a plan of this hummeller, the same letters marking corresponding parts in each. The sole frame *a a* rests on the floor of the corn-barn (see (1760.) and *k*, fig. 318); *b b* are two strong posts rising from the former, and secured to the beams of the floor above; *c* is a bridge-tree which supports the foot of the spindle *h*; two rings of wood *d d*, whose internal diameter is usually 10 inches, but varying according to the power of the machine, are supported by the uprights *f f f*, making the height of the cylinder 2 feet 3 inches. It is lined with wire-cloth, of 10 or 12 meshes in the inch, and placed between the posts *b b*, and is furnished

* Prize Essays of the Highland and Agricultural Society, vol. xiii. p. 66.

† Ibid. vol. xiii. p. 66.

with a bottom *g*, which just admits the spindle *h* to pass through, and having a thin shield on the spindle, over the opening. The spindle is $1\frac{1}{4}$ inch square; the blades *i i*, &c. of which there are 2 rows, 5 and 4 in a row, are 2 inches in breadth and $\frac{3}{8}$ inch thick, riveted into the spindle; or the blades may be cruciform, with

Fig. 353. Fig. 354.

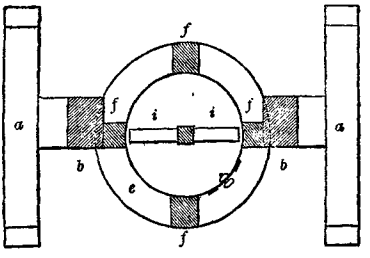


THE ELEVATION AND SECTION OF THE CYLINDER HUMMELLER.

an eye in the centre, through which the shaft passes. The hopper *k* may be either formed round the spindle, as in the figures, or it may stand to one side; and it may be furnished with a slider *l* to regulate the feed, though this is virtually done by the contraction or enlargement of the orifice below. From want of space here, the figs. 353 and 354 are represented broken off; but *m* is a bridge-piece bolted upon the posts *b*, to support the head of the spindle at *b'*, and also the end of the horizontal shaft *n*; the spindle *h* and shaft *n* carry the mitre-wheels *o* that give motion to the spindle. The spindle requires to have a velocity of 300 to 400 per minute, and the motion may be conveyed in various ways, suited to the general arrangements of the machinery. In the present case, it

is brought at once from the great spur-wheel by a pinion of the same size as that of the drum, the pinion occupying the position of the doted circle d' in fig. 319, Plate XIX.; and its shaft is supported on a bracket appended to the beam c of that figure, at the one end, while the other has a bearing in the wall that separates the barn from the engine-house.

Fig. 355.



THE PLAN OF THE CYLINDER HUMMELLER.

(1880.) Amongst the auxiliary implements of the barn that may be driven by the power, I have already given the details of the straw-cutter, the corn-bruiser, and the hummeller. There remains for me to say a few words relative to the means of *driving* them.

(1881.) The natural position for the *straw-cutter* is in the straw-barn, and as near as possible to the point of delivery of the straw from the thrashing-machine. Though there is considerable diversity in the relations of the parts where the straw is delivered, yet, in general, the arrangement is such as will admit of a straw-cutter being placed in a position similar to that in fig. 319 (1761.), where k represents the position of that machine. If the straw-barn is furnished with a loft,—which is sometimes the case—the straw-cutter is placed upon it, somewhat in the position here shewn. If there is no loft—as in the present case—a platform of 10 feet by 5 feet is to be raised, at a height of 8 or 9 feet from the ground-floor. It is constructed with two posts and two needles or beams, each having one end resting in the wall, and the other on a post; a joisting and floor are laid over these, and the machine placed thereon. In either case, whether on the platform or a floor, an opening is to be cut through the flooring immediately under the machine, of about 18 inches square; and this is formed into a hopper, to lead the cut straw or hay down to the ground floor, where it may be received either into a chamber boarded off, or into large canvass bags hooked to the bottom of the hopper.

(1882.) The mode of driving a straw-cutter so placed, is of easy accomplishment. The knife-wheels may be made to revolve from 180 to 220 turns a minute, so we have only to select a shaft, amongst the geering of the thrashing-machine, that may be made to produce the required velocity through the medium of a belt. The drum-shaft may, in general, be convertible to the purpose; but it involves this inconvenience, that the drum must be always in motion when the straw-cutter is at work. Where the power is ample—as the steam-engine—this is no inconvenience, for the straw can be cut during the whole time of thrashing, if necessary; and if this be not required, the belt of the straw-cutter is taken off or turned upon the loose pulley. There is an arrangement preferable to this, by adopting a separate motion for the straw-cutter and the corn-bruiser only; and this can in most cases be adopted. It consists in a light pinion, adapted to the great spur-wheel, and of such diameter as will bring out the proposed velocity. The pinion works near the crown of the wheel, and one end of its shaft has a bearing on the shaker-framing, while the other end is supported on a movable bridge-tree, by which means the pinion is easily engaged or disengaged with the wheel. The pinion-shaft carries also a pulley for the belt that drives the straw-cutter; and when the arrangement is properly adjusted,

it forms a very effective and convenient mode of producing the desired motions. When straw is cut while the thrashing-machine is at work, it becomes the duty of one of the persons employed in removing the straw from the thrashing-machine, to fork up a quantity, as required, to the platform of the straw-cutter, where a person is stationed to feed that machine.

(1883.) *The corn-bruiser*, when taken in connection with the straw-cutter, cannot be more conveniently placed than in the position marked *i*, in fig. 319. (1761.). It is placed over a hopper inserted in the floor, fitted with a spout that descends to a convenient height from the floor of the corn-barn; and here the bags are hooked on to receive the bruised grain as it descends from the rollers of the corn-bruiser.

(1884.) The pinion and shaft, with its pulley, described (1882.), for driving the straw-cutter, carries also a pulley for the corn-bruiser; or, as the speed of the two machines may be alike, a drum-pulley, placed on the shaft, will serve for both.

(1885.) It will be always desirable that the straw-cutter and corn-bruiser may be worked together, independent of the thrashing-machine. To accomplish this, it becomes necessary to have the means of disengaging the drum-pinion from the spur-wheel; and to do this, the simplest mode perhaps is to fit the drum-pinion upon its shaft with a feather or slide-rib, and to slide it out or in of geer with a fork-lever, acting in a collar attached to the pinion. If the geering of the feeding-rollers is constructed on the principle laid down in fig. 322, Plate XX, they are also easily disengaged, as described in (1765.); and the shakers likewise can be disengaged by withdrawing the intermediate wheel *k*, in fig. 319, Plate XIX, upon its stud, till it is free of the wheels on either side.

(1886.) By means of these disengagements, the operation of cutting and bruising can be carried on without incurring any unnecessary tear and wear of those parts of the thrashing-machine that move at high velocities, or that would otherwise be kept in action unnecessarily. On this part of the subject, I may remark that now, when we come to perform different processes by mechanical agency in connection with thrashing, by one first mover, we find *all thrashing-machines defective of the means of disengagement.* It is true that, in thrashing alone, all the branches of the process must go on together, and, therefore, disengagements cannot be admitted; or the only disengagement that can be made, with safety to the machine, would be the feeding-rollers; the effect of which would be to produce a cessation of all the branches of the process of thrashing, although all the machinery were kept in motion, except the rollers and their geering. It would nevertheless be advantageous, for various reasons, that the entire machine could be easily and instantaneously disengaged from the first mover, such as in case of accidents occurring, or the like; and this could be done effectively by means of friction-straps. But it is the introduction of processes differing from and independent of each other, and which may require to be carried on either simultaneously or separately, that will ultimately demand convenient means of engaging and disengaging the different departments of these machine-labours, though, owing to the entire neglect of such appliances in the original construction, the difficulty and expense of applying these conveniences to old machines are considerably increased.

(1887.) The driving the hummeller has been already adverted to and described as far as seemed requisite; but there are other operations to which a power may be applied. Amongst these *churning*, on some farms, is an import-

ant one, and its details will be taken up in due season; at present, however, the application of the power to that process may be considered. In very few cases would it be advisable to attach a churning-machine to a steam-power whose primary object was thrashing, unless it were constructed for the latter upon a small scale. Various reasons occur for this exception, and the most striking is, that, as churning is chiefly required in that season when thrashing is least frequent, the steam would be required much more frequently for the churn than for the thrashing-machine; but as the churn can never require more than one horse-power, there would be a waste of expense in raising the steam for probably a four or a six-horse engine to perform the work of one horse, which, with any view to economy, can never be recommended, unless coal be very cheap in the locality. It has been shewn (1841.) that the consumpt of coal for a six-horse non-condensing engine is about one cwt. per hour, and as the churning process seldom exceeds two hours in duration, the expense of raising the steam would be large in proportion to that required for the actual operation. But in a situation where the extent of grain-bearing land is small compared to pasture for dairy purposes, and where water-power might be unattainable, and coal at a moderate price, then a steam-engine of two or three horse-power could be advantageously adapted to serve all purposes. Water-power, however, will be always most advantageously applied to churning, for with that element employed as a power, it can be dealt out in any required amount. Horse-power, if admissible at all, may be allowed to the churn, and, with due attention to the means of disengagement pointed out in (1886.), the horse-wheel of the thrashing-machine may be applied to the purpose; for were the entire thrashing-machinery disengaged from the power, one horse might be capable of moving even a six-horse-wheel, and thereby work the churn. In adapting a churn to power of any kind, the arrangement of the parts must depend entirely on local circumstances; but the speed, for a vertical churn, may be about 60 strokes per minute, and for a box-churn, whether horizontal or vertical, the plunger should make about 60 revolutions per minute.

(1888.) *The Circular Saw*, as an auxiliary on an extensive farm, is a machine that should always be at hand, especially if a water or steam power is employed. Its position will, in general, be most conveniently appropriated adjacent to the steam-engine, or if water is the power, one roof will generally cover both the water-wheel and the saw-mill. In taking off the power for a saw, from the steam-engine, the most direct method is to convert the fly-wheel into a large pulley, either by affixing a wooden segmental ring to the arms of the wheel, or if the rim of the fly has a square edge, to apply a belt directly upon it, and from this it is easy to raise a motion suitable for the saw by pulleys and belts. The rate of a saw, for the purposes here in view, need not exceed 600 revolutions per minute, the saw being about 30 or 32 inches diameter. If the power is water, it is then taken off in the same manner, as described (1857.), by placing another and similar pinion on the wheel, as near as may be convenient, to that which drives the thrashing-machine, fig. 343, Plate XXV, the shaft of the pinion being supported on a movable bridge-tree, for the convenience of disengagement, the velocity is then raised to the required pitch by pulleys and belts as before.

(1889.) Under the present agrarian system, there are but few other operations to which mechanical power could be advantageously applied—owing to the circumstance that the power, if steam is employed, is only occasionally in opera-

tion; and even though water were the power, it is seldom procurable in such quantity as to warrant its constant or daily application for the minor purposes to which mechanical power may be applied. If power, however, could be made available *at all times* without incurring too much expense, the operation of slicing turnips, washing potatoes, twisting straw ropes, breaking oil-cake, besides other occasional but routine operations, might be all effected by means of it. And there is another process which has often occurred to me as one worthy of consideration, but which, if found deserving of attention, would rank higher than the minor processes named above. I allude to the manufacture of manure from straw, and to expedite the process of decomposition of that article in the cattle-courts. I am persuaded that chopping the straw, by a machine, into lengths of 2 to 4 inches, would not only expedite the conversion, but would render the quality of the manure better and more manageable in the course of distribution in the field.

(1890.) Regarding, further, the extension of the agency of steam, when it has been established on the farm in the shape of a steam-engine,—a question has frequently occurred, would it be economical to apply the boiler of the engine to the purpose of raising steam for a cooking apparatus for the stable and byre? To such a question, I have invariably answered in the negative, as applicable to the present system. But the question may be viewed in two ways. First, if thrashing is the sole purpose of the engine, or that it is never required to be in operation except when thrashing is going on, it would not, under such circumstances, be economical to use the boiler for steaming food; by reason of the quantity of fuel that it would consume, beyond that required for a small boiler proportioned to the steaming apparatus. Second, if the business of the farm was of such extent, and so arranged that the steam-engine would be required during some portion of every day, in this case the engine-boiler, by being a very small degree larger than usual, could not only serve the engine, but would supply the steaming apparatus at the same time, without increasing sensibly the consumpt of fuel, and the expense of the separate small boiler for the steaming apparatus would be saved. Under this second view, then, there would be economy in using the engine boiler for steaming, but only, be it observed, in conjunction with other mechanical operations that would in the aggregate give employment during some portion of the day to the full, or a large proportion, of the power; and it may safely be asserted, that the full advantages of steam on the farm will not be realized, until such arrangements as are here pointed at, have been developed.

(1891.) There is one other process to which power may be, I have no doubt, advantageously employed, but which is yet but little understood, that is, the *home manufacture of pure oil-cake*. The extensive adulteration of the common linseed oil-cake invites agriculturists strongly to adopt a home manufacture of that article; not to say a pure linseed cake, but such a portion of the seed as, when bruised, to set free its oleaginous matter, might be mixed up with bruised grain and cut straw, in the proportion that would yield the most nutritious food to animals (1484.). A mode of preparing nutritious food, based upon this principle, would certainly be more economical than the present oil-cake, and more especially, than the method proposed and acted upon by some feeders, who purchase the manufactured oil, and mix up straw with it (1482.).

(1892.) The steam-engine *boiler*, if in daily operation, may also be applied to the purposes of heating such of the premises as require that aid, and especially to the moderate drying of grain, when a damp season demands such pre-

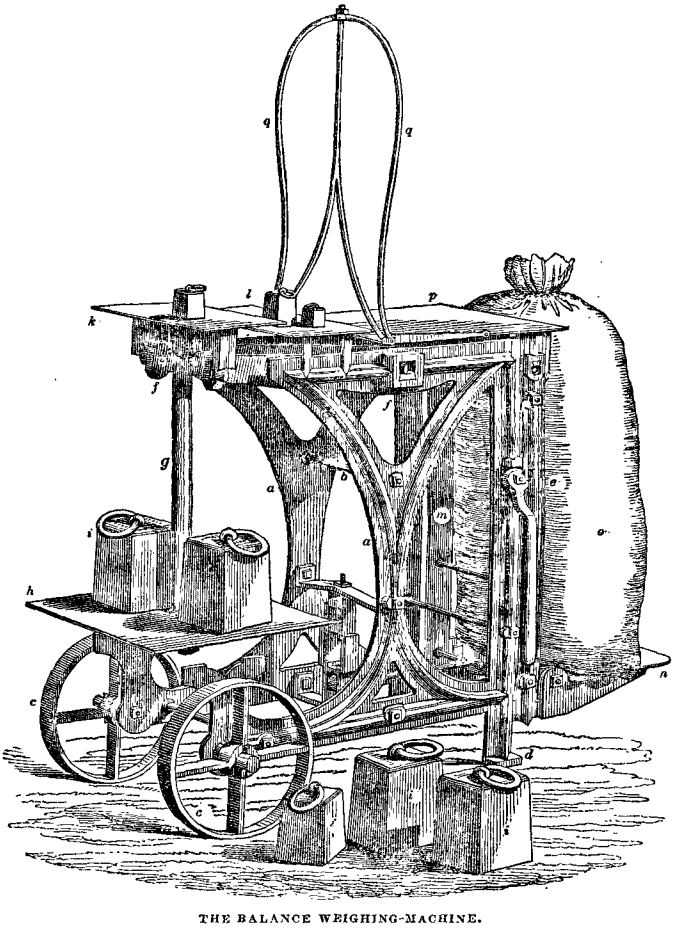
cautions. This latter process might be easily accomplished, by setting apart a small chamber, in which a convolution of steam-pipes should be laid under a wire-cloth, or other metallic floor; or, when a moderate heat only is required, the pipe might be simply laid round the chamber, above a common floor, and frequent turning of the grain resorted to. Other purposes might be pointed out, to which this agent may be applied in the farm-steading; but the present observations are made, more with a view to direct attention to the subject, than to dictate particular methods of accomplishing the object; and having thus digressed from the objects of the barn to the various objects of the *power* chiefly employed there, I now return to notice one or two articles of the barn not coming under mechanical agency.

(1893.) *The Weighing-machine* is an important article of the barn furniture, and various forms of it are resorted to. The common beam and scales is the most correct of all the instruments of the class; but it is defective, as being less convenient for the purposes of the barn, than several others that are partially employed. Steelyards of various forms are also used; but in all steelyards there are grounds for doubting their accuracy, in consequence of the operator not seeing the true counterpoise of the substance weighed, but only its representative, bearing an actual weight greatly smaller than the substance, but in the inverse proportion to it that the longer arm of the steelyard on which it is appended bears to the shorter arm. Many of these steelyards, from their compactness, are, however, greatly to be commended; and, when well constructed, and properly adjusted, will be found to answer the purpose of weighing such bulky articles as grain with sufficient accuracy. Their cheapness also, when compared with some other instruments on the beam and scale principle, holds out a great inducement for their adoption.

(1894.) *A weighing-machine*, on the balance principle, which combines every convenience for the setting on and removal of the bags of grain, with accuracy and neatness of construction, is exhibited in fig. 356. This machine is constructed chiefly of cast-iron, the frame-work *a* is connected by cross stretcher bolts *b*, and is supported in front on the wheels *c c*, while the back parts are supported on the feet *d*. The folding handles *e*, one on each side, turn on a joint pin at *e*, and become levers by which the machine can be moved about like a wheelbarrow. The beam, parts of which are seen at *f f*, is double, and also formed of cast-iron, with steel centres, the two bars forming the beam-stand 12 inches apart, and are connected by a diagonal truss. The one end of the double beam supports a crosshead suspended on the end centres of the beam, and to which is attached the pillar *g*, to the lower end of which is attached the shelf-plate or scale *h*, upon which the principal weights *i i* are placed. The crosshead carries also the top shelf or scale *k*, upon which the smaller weights are placed, and a dead-plate *l* is fixed on the frame-work on which the small weights stand ready for use. The opposite ends of the beam carry a frame *m*, only partially seen, to the lower end of which the shelf *n* is jointed, and upon this shelf the bag *o*, about to be weighed, is shewn in the figure. To the upper end of the frame *m* there is also attached, by a strong bracket not seen in the figure, the shelf or scale *p*, and upon this scale the bag may be placed and weighed with equal accuracy, while it is supported by the light frame *q q*. The object of the top and bottom weighing shelves is to suit the placement, or the removal of the bag, either from or to a man's back by the top shelf, or from or

to the load-barrow by the lower shelf. When the machine is not in use, the lower shelf is folded up against the back of the frame, and the light frame or back *q q* folds down over the lower shelf, reducing the machine to a very compact state. In weighing with this machine, from its being on the principle of the balance, the amount of weights required is equal to the absolute weight of the body that is being weighed, and the true weight is determined when the

Fig. 356.

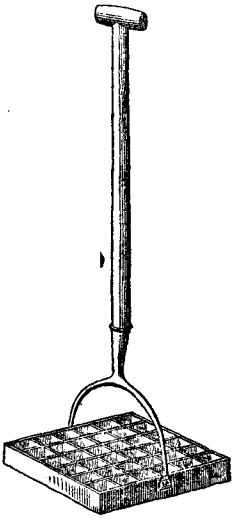


THE BALANCE WEIGHING-MACHINE.

scales or shelves *k* and *p* coincide in one level line with the dead-plate *l*. In constructing this machine, the bottom of the pillar *g*, and of the frame *m*, are provided with a horizontal connecting-rod, which preserves their parallelism, and, consequently, the correct indications of the beam. Weighing-machines are constructed, on the same principle, with wooden frame-work, which renders them lighter and cheaper; but from the changeable nature of the material, as

affected by moisture and dryness, they are liable to derangement. The price of the machine, as exhibited in the figure, is L.8, 10s.; and when constructed in wood, the price is L.5 to L.6.

Fig. 357.



THE HAND HUMMELLER.

(1895.) *The Hand-Hummeller.*—In the smaller class of farms, hand-hummellers are pretty generally used, and are of various forms, but all retaining one principle of construction and of effect. They are round, square, and oblong; but in all three forms, they consist of a number of parallel bars of iron, placed in a frame of one of the forms above named. Fig. 357 is a square hummeller in perspective. It consists of a square frame of iron, 12 inches each way, 2 inches in depth, and $\frac{1}{8}$ inch thick. Bars of similar dimensions are riveted into the sides of the frame, and crossing each other, forming compartments of from $1\frac{1}{2}$ to 2 inches square. A branched iron stem is riveted to the frame below and at top, and forms a socket into which a wooden helve is fixed, having a crosshead by which it is held in the hand. Such hummellers are frequently made with parallel bars only, in which case they are less expensive but much less effective.—J. S.]

(1896.) Systematic writers on agriculture, and most others, when treating of the various plants usually cultivated on a farm, always describe their characteristics in botanical phraseology; and though this way of describing them seems a proper one, when different genera of plants have to be distinguished from each other; yet when more varieties of the same species, and especially when those varieties are numerous, have to be treated of, a more natural method of describing or classifying them seems desirable, so as they may easily be distinguished by other people than botanists. Thus, Professor Low, when treating of wheat, enumerates 11 different subdivisions* which are cultivated, all which, doubtless, possess distinct botanical characteristics; but the distinction betwixt these are not likely to be apprehended, far less applied, by the majority of farmers; and much less likely still are they to discriminate, with botanical accuracy, betwixt the very numerous varieties that are now cultivated in different parts of the empire. Mr Lawson has described 83 varieties of wheat,† and Colonel Le Couteur mentions having in his possession, in 1836, no fewer than 150 varieties;‡ and the Museum of the Highland and Agricultural Society in Edinburgh possesses 141 varieties.§ To distinguish between all these, with botanical exactness, would puzzle any farmer.

(1897.) For this reason, it has occurred to me, that some method should be established of recognizing the different kinds of grain in use, by their external characters in the ear and in the grain. Colonel Le Couteur has given a classification of wheat involving the principle I have mentioned, and he gives a similar reason for attempting it, when he says,—"No one has done so, as a branch

* Low's Elements of Practical Agriculture, p. 229.

† Lawson's Agriculturist's Manual, p. 29.

‡ Le Couteur on Wheat, p. ii. Dedication.

§ Catalogue of the Museum, p. 63-6.

of agriculture, in those plain terms which may be intelligible, not to the botanist or scientific reader only, but to the great mass of farmers." And the principal object he considers to be held in view, in attempting such a classification, is, that the nature and real qualities of each variety may be ascertained as to their properties for making bread.*

(1898.) In prosecuting his ideas of a classification, Colonel Le Couteur divides all the varieties of wheat into two classes, namely, *beardless* and *bearded*. In so far he imitates the modern botanists, who divide the cultivated varieties of wheat into the two divisions of *barbatum* and *imberbe*, signifying the above characteristics; but, unfortunately for the stability of this division, the distinction is not immutable, for some bearded wheat lose their beards on cultivation, and some beardless ones are apt to become bearded, when cultivated on poor soils and exposed situations. Some of the other grains indicate a tendency to this sort of degeneracy, for even the potato-oat assumes a beard when sown a long time on the same ground in a poor state. He then subdivides beardless wheat into white, red, yellow, and liver-coloured, smooth chaffed and velvet chaffed; and the bearded he divides under the same colours. Some varieties of wheat are, no doubt, decidedly downy on the chaff, but others, again, are so little so, that it is difficult to distinguish them from some of the roughest varieties of smooth chaffed; and it is well known, that the same wheat will be differently affected, in that respect, by the soil upon which it has been grown; for a sharp soil has a tendency to render the chaff and straw smoother and harder than a deaf soil, which has a tendency to produce soft and downy chaff and straw. This downiness, therefore, is not so fixed and important a character as to be adopted to rank one great division of wheat under its denomination. The associating together the characters of wheat in grain and in the ear, is also, in my opinion, injudicious, inasmuch as neither character separately can positively indicate the state of the other, as I shall soon shew, and both are not required to indicate the flouring properties of any variety of wheat, in respect to its superiority in making bread. A baker will at once distinguish the grain which will afford the flour best suited for bread, but he could indicate nothing of its properties by an ear of wheat. Colonel le Couteur puts down a liver coloured wheat, as a distinctive colour, along with others. I confess I cannot distinguish this colour; for I never remember to have seen wheat of a liver-brown colour. I think all the colours of wheat may be classed under two of the primary colours, *yellow* and *red*, for even the whitest wheat has a tinge of yellow in it, and the brownest wheat is deeply tinged with red; but as *white* and *red* are the terms by which the colours of wheat have been longest known, these should be retained. The variety of wheat which should form the standard of each colour has never yet been settled; but judging from the collection of wheat in the Highland and Agricultural Society's Museum, I should say that the Hungarian white wheat, *a*, fig. 358, indicates the purest white, and the blood-red wheat the purest red.

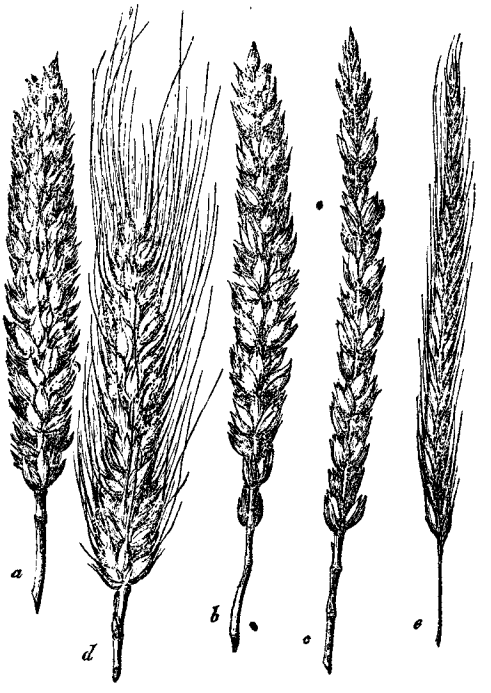
(1899.) Were I to attempt to classify wheat by *natural marks*, I would make two classifications, one by the ear and the other by the grain, so that each could be described by its own characteristics, and, if desirable, either could be illustrated by the characteristics of the other. In this way confusion would be avoided between the characters of the ear and of the grain. The farmer who grows the wheat in the ear and sells it in the grain should be acquainted with both; but

* Le Couteur on Wheat, p. 77.

the baker, who is only acquainted with grain, knows nothing by the ear. Were he, however, to receive an ear of each variety of grain he purchased, he would be able to describe at once to the farmer what particular variety afforded him the flour best suited for his purpose.

(1900.) *Wheat*.—On examining the *ears* of wheat that have come under my notice, I think they may be divided into the 3 classes, as represented in fig. 358, and which may be distinguished thus: *a* is a *close* or *compact* eared wheat, which is occasioned by the spikelets being set near each other on the rachis or jointed

Fig. 358.



CLASSIFICATION OF WHEAT BY THE EAR. EAR OF RYE.

stem, and this their position has a tendency to make *the chaff short and broad*, and the spikelets are so also. This figure, as well as the others, shew the ear half the natural size. This specimen of the close-eared wheat is Hickling's Prolific. The second class of ears is seen at *b*, the spikelets being of *medium* length and breadth, and placed just so close upon the rachis as to screen it from view. The ear is not so broad, but longer than *a*. The *chaff* is of *medium length and breadth*. This specimen is the well known Hunter's white wheat. The third class is seen at *c*, the spikelets of which are set *open*, or so far asunder as to permit the rachis to be easily seen between them. The ear is about the same length as the last specimen, but is much narrower. *The chaff is long and narrow*. This is a specimen of Le Couteur's Bellevue Talavera white wheat. These three classes of varieties constitute the *Triticum sátivum imberbe* of botanists, that is, all the varieties of the beardless cultivated wheat. Formerly they were divided by botanists into *Triticum hybernum* or winter wheat, and *Triticum æstivum* or

summer wheat; but experience has proved that the summer wheat, so called, may be sown in winter, and the winter wheat sown in summer, and both thrive. Paxton says that Triticum is derived from "*tritum*, rubbed; in allusion to its being originally rubbed down to make it eatable." * It is of the natural order *Gramineæ*, and of the third class *Triandria*, and second order *Digynia*, of the Linnæan system.

(1901.) In *d*, fig. 358. is represented a bearded wheat, to shew the difference of appearance which the beard gives to the ear. The bearded wheats are generally distinguished by the *long shape* of the *chaff* and the open position of the spikelets, and therefore fall under the third class. But cultivation has not only the effect of decreasing the strength of the beard, but of setting the spikelets closer together, as in the specimen of the white Tuscany wheat, shewn at *d* in the cut, which is considered the most compact eared and improved variety of bearded wheat. Bearded wheat constitutes the second division of cultivated wheat of the botanists, under the title of *Triticum sativum barbatum*. The term bearded wheat is used synonymously with spring wheat, but erroneously, as some beardless wheat is as fit for sowing in spring as bearded, and some bearded may be sown in winter. Figure *e* is a specimen of *rye*.

(1902.) In regard to classifying wheat by the *grain*, on observing a great variety of forms, I think they, as well as the ears, may all be classed under 3 heads. The first class is shewn at *a*, fig. 359, where all the grains are *short*, *round*, and *plump*, with the bosom distinctly enough marked, and well filled up. In the cut, the grain to the left is seen with the median line along its bosom; another, below it, with the round or opposite side lying undermost; and the third and fourth, shew the germ and radicle ends respectively. All fine *white* wheats belong to this class, and they are enclosed in *short*, *round*, and generally *white chaff*,

Fig. 359.

CLASSIFICATION OF WHEAT BY THE GRAIN.

which, when ripe, become so expanded as to endanger the falling out of the grain. Very few *red* wheats belong to this class. In reference to the ear, this class is found in *short-chaffed* and broad spikelets, which are generally compact. The specimen here is Hungarian white wheat. The second class is represented by *b*, where the grains are *long and of medium size*, that is, longer and larger than the grains of the first class. The *chaff* is *also medium-sized*. In reference to the ear, it is of the *medium* standard, in respect to breadth and closeness of spikelets, though *medium-sized grain* is *not* confined to this sort of ear; for it is

* Paxton's Botanical Dictionary, *Triticum*. See also Hooker's British Flora, p. 20, edition of 1831.

found in the *compact* ear, as in Hickling's Prolific white and red wheat, as well as in the *open* ear, such as the red Danzig creeping wheat. Most of the *red* wheats belong to this class of grain, though many of the *white medium-sized* —such as Hunter's white—also belong to it. This specimen is the Caucasian red wheat, whose ear is bearded, and belongs to the open-spiked class *c*, fig. 358. The figure at *c*, fig. 359, represents the third form of grain, which is *large and long* to a greater degree than the last class. Its *chaff* is *long*, and in reference to the ear, the spikelets are generally open, though, in the case of this specimen, the Odessa long white wheat, the ear is medium-sized, though the chaff is long as well as the grain. The three sorts of wheat in the cut are all placed in similar positions, and are of the natural size.

(1903.) It will be seen from what has been stated, that no direct relation exists between the *ear* and the *grain*; that the compact ear does not always produce the round grain nor the white wheat; that in the medium ear, is not always found the medium-sized grain; and that the open ear does not always produce the large long grain. But still, there exist coincidents which connect the *chaff* and the *grain*. For example, the *length* of the *chaff* indicates the *length* of the *grain*, upon whatever sort of ear it may be found; and, generally, the *colour* of the chaff determines *that* of the grain. As also, the open spikelet bears grain of coarser quality than the compact. On wishing, therefore, to determine the sort of *grain* which any number of *ears* of different kinds of wheat may contain, it is the *form* and *colour* of the *chaff* that determines the point, and not whether the ear carries compact, medium, or open spikelets, or whether it be bearded or beardless, or whether it be woolly or smooth.

(1904.) But a more important consideration than its classification, in regard to wheat, is the mode of *judging* it, to ascertain the purposes to which it may be best employed, in the particular condition in which it may be seen. These purposes are, for seed and for the making of flour; whether the flour is to be employed in the manufacture of bread or of confections, or in some of the arts, such as starch-making. In its *best* condition, all wheat, whether red or white, small or large, long or round, should appear plump within its skin, not in the least shrivelled or shrunk. The skin should be fine and smooth, not in the least scaly or uneven in surface. The colour, be what tint it may, should be bright, lively, and uniform, not in the least dull, bleached, or party-coloured. The grains should all be of the same size and form, not short and long, round and long, small and large. The grains should be quite perfect, there should be no bruises, or holes, or dried rootlets hanging from the dimpled end, or woolly appendage from the other end. If perfect in all these respects, wheat is fitted for any purpose, and may be purchased by the general merchant. For particular purposes, additional properties must be regarded.

(1905.) When wheat is quite opaque, indicating not the least translucency, it is in the best state for yielding the finest flour, such flour as confectioners use for pastry; and in this state it will be eagerly purchased by them at a large price. Wheat in this state contains the largest proportion of fecula or starch, and is therefore best suited to the starch-maker, as well as the confectioner. On the other hand, when wheat is translucent, seemingly hard and flinty, it is best suited to the common baker, as affording what is called *strong* flour; that is, flour that rises boldly with yeast into a spongy dough, or, in other words, the wheat then contains the largest proportion of gluten. Bakers will, therefore, give more for good wheat in this state than in the opaque; but for bread

of first quality the flour should be fine as well as strong, and therefore a mixture of the two conditions of wheat is best suited for making the best quality of bread. Bakers, when they purchase their own wheat, are in the habit of mixing wheats that respectively possess those qualities; and millers who are in the habit of supplying bakers with flour, mix such wheats and grind them together for the special purpose. Some sorts of wheat, however carefully they may have been preserved pure, naturally possess *both* these properties, and on that account are great favourites with bakers, though not so with confectioners; and I presume, to this mixed property is to be ascribed the great popularity which Hunter's white wheat has so long enjoyed. We hear of "*high mixed*" Danzig wheat, which has been so mixed for the purpose, and is in high repute amongst bakers. Generally speaking, the lightest-coloured white wheats indicate most opacity, and, of course, yield the finest flour, and red wheats are most flinty, and therefore yield the strongest flour; for a translucent red wheat will yield stronger flour than a translucent white wheat, and yet a red wheat never realizes so high a price in the market as white, because it contains a larger proportion of refuse in grinding.

(1906.) For *seed*, the dimpled end of the grain should be distinctly marked, and the site from which the rootlets issue should be rather prominent; and the end from which the blade springs should be covered with a slight degree of woolliness or hairiness. The protuberances of the rootlets and woolly ends should not have been rubbed off by any process, such as sheeling, as the grain is thereby rendered unfit for seed, by being deprived of its vitality. Nor should the grain have been kiln-dried, because that process may also deprive it of vitality, and its effects may partly be detected in the undue hardness of the grain, and partly also from the smoky flavour which the grain has acquired. But hardness alone is not a sufficient criterion, as some wheats become much harder in ordinary drying than others; and in some parts of the Continent, such as on the shores of the Mediterranean, some wheats are naturally so hard as to induce that in the ordinary state to be called soft. If no smokiness can be detected in the flavour, the surest test of existing vitality, when time is allowed to apply it, is to germinate the wheat near the fire, in a glass, amongst as much water as will swell the grains.

(1907.) *Damaged* wheat may be detected in various ways. If it has been in sea-water, although it may not be enlarged by moisture, it can never lose the saline taste; and although it may have been washed in fresh water and dried in a kiln, still the washing gives it a bleached appearance, and the subsequent drying may be detected by either the smell or the taste. Wheat that has been sheeled, to make it look round and plump, may be detected by the appearance of the ends being rubbed down. Wheat that has been heated in the stack, though not affected in colour, will taste bitter on being chewed. Wheat that has been long in the granary appears dull and dirty, though it may have been passed through the fanners; and although it may not have been injured, it always contracts a musty smell. Wheat is liable to the attacks of insects in the granary, which breed within its shell and eat the kernel. This mode of destruction, occasioned by the weevil, is easily detected by the grain feeling light in hand, and the holes may easily be seen from which the perfect insect has made its escape. Germinated, swollen, burst, bruised grains, as well as the admixture of other kinds of grain and seeds, are easily detected by the eye.

(1908.) Difference of opinion exists in regard to the *best mode of preserving*

wheat in granaries. The usual practice is to shovel the heap over from the bottom every few weeks, according to the dryness or dampness of the air, or heat or coldness of the atmosphere. In this mode of treatment, a free ventilation of air is requisite in the granary, and the worst state of the atmosphere for the grain is when *moist* and *warm.* Extreme heat or extreme cold are preservatives of grain. The practice of others is not to turn over their wheat at all, but to keep it in very thick masses, reaching from the floor to the ceiling, and quite in the dark. No doubt, if air could be excluded effectually from a granary, the grain could be preserved in it without further trouble; and a good plan of excluding the air entirely seems to be to heap the wheat as thick together as possible. There is as little doubt, however, that wheat which has been kept long in heap without turning, retains its colour in a fresher state than that which is frequently turned; and a good plan for preserving the colour seems to be to keep wheat in the dark. The ancients used to preserve grain many years, to serve for food when years of famine overtook them. When Joseph was in Egypt, wheat was preserved for seven years in the stores, but this might not be a difficult matter in so dry a climate as Egypt; and in Sicily, Spain, and in the northern parts of Africa, pits were wont to be formed in the ground to preserve grain; and the Romans were so impressed with the necessity of preserving grain, that they took great pains in the construction of their granaries, which are related to have kept wheat for 50 and millet for 100 years.* But as to the farmer, the question how wheat is best preserved in granaries, should little affect him, as the best way of keeping his wheat is in the straw in the stack; and when the stacks are thrashed for the straw, he should dispose of his wheat immediately, and take the current market-prices. In a series of years, during the currency of a lease, this is his safest practice; and besides securing him, in the long run, of an average price, it saves him a great deal of trouble in looking after the grain, and a great deal of vexation when prices fall below their expected amount. Two friends of mine, farmers, were both great losers by keeping wheat of their own growth on speculation. They each stored three years' crop, and though offered L.6 a quarter for it, they kept it, with the view of obtaining more, but were never offered so much again; and after prices dropped gradually to 65s., and were not likely to rise immediately, they sold off the whole stock. Such is most likely to be the fate of most farmers who speculate in wheat, even of their own growth; but when they venture on purchasing the wheat of others, they forego their proper profession, and become merchants, and thence become involved in the intricacies of trade, of which they must be quite ignorant; and probably only become sensible of their ignorance after feeling the effects of their temerity.

(1909.) Wheat is prepared for the use of man by being ground into *flour.* The machinery used for grinding wheat consists of a number of parts, each of which performs its separate work, and they are all strongly constructed. The first process which wheat undergoes in grinding is in being put through the *sheeling cylinder,* which rubs off any extraneous matter belonging or adhering to the outer skin of the grain, and separates every foreign matter from the wheat. In this process, the wheat is made shorter in length, brighter in colour, and freed from every impurity. The quantity of black suffocating dust which flies off from the cylinder in the process of sheeling, and the seeds and other substances, which are separated from the grain, are collected together, surprise every one

* Dickson's Husbandry of the Ancients, vol. ii. p. 426.

who has never witnessed the process, how such impurities can have proceeded from an *apparently clean sample.* After the sheeling, the prepared wheat is put into a large hopper, which conveys it to two millstones of French bhurr, to be ground.* In the grinding, the wheat is converted into flour, which still contains all the ingredients of the wheat, and has acquired a high degree of temperature. In order to cool it, which should be done as quickly as possible, it is immediately carried to the well ventilated cooling-room, to be spread upon its wooden floor, and turned frequently over with a wooden shovel, should the grist have been so large as to cause it to be laid thick on the floor. After it has been thoroughly cooled, it is made to descend from the cooling-room, by a hopper, into the *boulting or dressing cylinder*, in which it is separated into its respective parts by being brushed through wire-cloth of different sizes. These parts usually consist of *firsts*, or fine flour; of *seconds*, or second flour; of *thirds*, or sharps; of *broad* or coarse bran, and of *fine* bran. Sometimes the coarse bran only is taken from the flour, which is then said to be ground *overhead*, and makes good coarse household bread. Sometimes the fine bran is taken out from the overhead flour, and the coarse flour makes a sweet coarse bread. On the other hand, a smaller quantity of the fine is taken out of the bulk of flour, in order to make the finest as fine as possible, and this is used for pastry and fancy bread; and in this case, the seconds flour becomes finer, and makes the seconds loaf of superior quality. More or less of fine flour is taken out in dressing, by merely shifting a hinged board under the dressing cylinder, so as to embrace a larger or smaller space of the upper or finer portion of the wire-cloth of the cylinder. When a large proportion of the bulk is made into first flour, this flour is not fine, and the seconds flour is thereby reduced in quantity and made coarser. The sharps, or that portion which consists of the heart of the grain, and which is broken and escapes from between the millstones, are used by biscuit-bakers. The first or broad bran is used for bran-mashes, and mixing with horse-corn; and the fine bran is employed to feed poultry and pigs. As you have seen that the butchers of London cut up carcasses of meat in a greater number of pieces than those of this country; so the millers there dress the flour in a greater number—no less than seven distinct—sorts. These sorts are thus divided from the flour of a quarter of wheat of 8 bushels—

Fine flour,	5 bushels	3 pecks.
Seconds,	0 ...	2 ...
Fine middlings,	0 ...	1 ...
Coarse middlings,	0 ...	0½ ...
Bran,	3 ...	0 ...
Twenty-penny,	3 ...	0 ...
Pollard,	2 ...	0 ...
Total,	14 bushels	2½ pecks.

So that grinding nearly doubles the bulk of flour and bran above that of the wheat.

(1910.) Whether flour is properly *ground*, is judged of on being taken into the hand as it falls from the spout leading from millstones. It is rubbed by

* See Ure's Dictionary of the Arts, art. *Millstone*, for an account of this remarkable substance.

the thumb against the side of the fore finger, and if it feel pleasantly smooth, without being greasy or rough, it is well. When the outer edge of the millstones are set too close, the flour feels greasy, because it has been too much bruised—or *killed*, as it is termed—and it does not then easily rise with yeast in the making of bread. When the stones are set too far asunder, the grain accumulates under the eye of the millstone, and is there *broken*, which breaking prevents the skin of the grain being separated from the substance, and the consequence is, that the bran feels thick, rough, and heavy, and there is much waste of substance. Whether flour is properly *dressed* is ascertained in the same way by rubbing the fine flour between the thumb and fore-finger, and, if it feel smooth and even, not in the least rough or gritty, it is well. To judge still further whether the flour has been perfectly dressed, if, on being pressed with a polished article, such as the back of a plain gold or silver watch, or the back of a silver spoon, the smooth pressed surface present no minute brown spots of bran to a good sight, it is clean dressed; and if any such cannot be detected by a good magnifying glass, it is as perfectly dressed as practicable with the present form of the machinery. When the large bran is inspected, and it is found to be entirely skin and no white substance of the wheat adhering to it, the grinding has been well executed; and in this state the bran, on being thrown upwards, will fall lightly towards the ground, being in large thin flakes. The small bran has always a part of the substance of the wheat attached to it; because it is chiefly derived from the groove which forms the bosom of the grain, and is only generated after the large bran has been sloughed off, and a portion of the grain itself ground down to the level of the groove. There is no means of judging whether any parcel of flour will make good bread, the *flour* of the opaque and flinty wheats being undistinguishable from one another, and it is perhaps this difficulty which induces bakers to buy wheat, and get it made into flour on their own account; otherwise the simplest plan for them would be to buy the sort of flour they want. On account of this practice of the bakers, many of the flour millers in Scotland grind only on hire.

(1911.) Flour is put up in what are called *sacks* of 280 lb., or 20 stones imperial. It is rendered firm in the sack by the sack being occasionally beaten against the floor by means of a fork-lever, when filling at the spout leading from the dressing-machine. Of wheat weighing about 64 lb. per bushel, $4\frac{1}{2}$ or 5 bushels will be required to make a sack of fine flour. Of the fine crop of 1815, I remember of the late Mr Brown, Whitsome Hill, Berwickshire, selling to Mr Mackay of Clarabud Mill, in the same county, 800 bolls, or 4800 bushels, of red Danzig creeping wheat, which weighed 27 stones per boll, or 63 lb. per bushel, and yielded 24 stones of fine flour, and only 3 stones of refuse, that is, only $\frac{1}{9}$ of refuse of the entire weight.* I find the fine white wheat used by the bakers of Edinburgh yield $13\frac{1}{2}$ st. of 14 lb. of flour from 4 bushels, weighing 18 st., and 2 st. of odd, seconds, parings, sharps, and waste, and $2\frac{1}{3}$ st. of bran.

(1912.) Many devices are practised to *adulterate flour*. I remember a miller in Cornwall being fined in very heavy penalties for adulterating his flour with washed felspar obtained from the disintegration of the granite of his neigh-

* As an instance of the great fluctuation in the price of wheat, occasioned by a difference in seasons, I may mention that part of this fine wheat was sold in 1815 for 32s. per boll of 6 bushels, or 5s. 4d. per bushel; and in August 1816, a very wet season, part was sold for 105s. per boll, or 17s. 6d. per bushel.

bourhood. Potato-flour and bean-flour are mixed with wheat-flour, and though not positively unwholesome, or perhaps unlawful, are frauds when so used, as being articles of inferior value to the flour of wheat. There are modes, however, of detecting any kind of adulteration. "If potato-flour be added," says Dr Ure, "which is frequently done in France, since a vessel which contains 1 lb. of wheat-flour will contain 1½ lb. of potato-flour, the proportion of this adulteration may be easily estimated. If gypsum or ground bones be mixed with flour, they will not only increase its density still more, but they will remain after burning away the meal."—"Bean or pea flour may be detected by pouring boiling water upon it, which developes the peculiar smell of these two substances."—"Nitric acid has the property of colouring wheat-flour of a fine orange yellow, whereas it does not affect the colour of potato-flour."—"Pure muriatic acid colours good wheat-flour of a deep violet, but dissolves potato-fecula."—"As fecula absorbs less water than flour, this affords a ready means of detection."—"Alum may be detected in bread by treating the bread in water, and pouring a few drops of nitrate or muriate of barytes in it, when a heavy white precipitate will follow, indicating the presence of sulphuric acid."* "Guaiacum," says Dr Thomson, "is rendered *blue* by various animal and vegetable substances. It becomes blue, according to Tadei, when rubbed in the state of powder with gluten of wheat, or with the farina which it contains."† If a little of this gum and water be put amongst flour, it is a very good and easy test of its soundness when the flour becomes *blue*. "It has been found so difficult to detect the adulteration of flour," remarks Mr Babbage, "and to measure its good qualities, that, contrary to the maxim that government can generally purchase any article at a cheaper rate than that at which they can manufacture it, it has been considered more economical to build extensive flour-mills, and to grind their own corn, than to verify each sack purchased, and to employ persons in continually devising methods of detecting the new modes of adulteration which might be resorted to."‡

(1913.) Any one may analyze flour in this way: "A ductile paste is to be made with 1 lb. of flour and a sufficient quantity of water, and left at rest for an hour; then having laid across a bowl a piece of silken sieve stuff a little below the surface of the water in the bowl, the paste is to be laid on the sieve, on a level with the water, and kneaded tenderly with the hand, so as merely to wash the starchy particles out of it. . . . . The water must be several times renewed, until it ceases to become milky. The gluten remains on the sieve."§

(1914.) The analysis of wheat and flour by the celebrated Vauquelin gave the following results. It may be observed, however, of the wheat and flour subjected to this analysis, that they were of foreign growth, and the results cannot be adopted for practical purposes in this country, as if they had been obtained from British wheat and flour. "In general," says Davy, "the wheat of warm climates abounds more in gluten, and in insoluble parts; and it is of greater specific gravity, harder, and more difficult to grind."‖

* Ure's Dictionary of the Arts, art. *Flour of Wheat.*

† Thomson's Organic Chemistry, *Vegetables*, p. 535.

‡ Babbage on the Economy of Machinery and Manufactures, p. 102.

§ Ure's Dictionary of the Arts, art. *Bread.*

‖ Davy's Lectures on Agricultural Chemistry, p. 136, edition of 1839.

Components.	French wheat.	Odessa hard wheat.	Odessa soft wheat.	Ditto.	Flour of Paris bakers.	Ditto of good quality, and in public establishments.	Ditto, inferior kind.
Starch .	71.49	56.5	62.00	72.00	72.8	71.2	67.78
Gluten .	10.96	14.55	12.00	7.30	10.2	10.3	9.02
Sugar . .	4.72	8.48	7.56	5.42	4.2	4.8	4.80
Gum . .	3.32	4.90	5.80	3.30	2.8	3.6	4.60
Bran . .	...	2.30	1.20	...	...	...	2.00
Water . .	10.00	12.00	10.00	12.00	10.0	8.0	12.00
	107.49	98.73	98.56	100.02	100.0	97.9	100.20 *

It appears that Odessa wheat contains more sugar than French wheat. The gluten mentioned here is a mixture of gluten and albumen. The gum has a brown colour, and contains azote. It is the gluten which gives to a mixture of flour and water its tenaciousness, ductility, and elasticity, and forms the nourishing property of loaf-bread. Gluten has a great resemblance to animal tendon or membrane, containing no less than 14½ per cent. of azote. When subjected to fermentation, which is of a peculiar character, and has thereby obtained the appellation of *panary* fermentation, a considerable volume of carbonic acid gas is evolved, but which is retained in the mass of the dough by the tenacity of the gluten. Thus confined during its evolution, the gas expands the dough to nearly double its pristine volume, and gives it its vesicular texture; and it is the infinite number of these cellules, filled with carbonic acid gas, and apparently lined with a glutinous membrane of a silky softness, that gives to the well-baked loaf that light, elastic, porous constitution, which *good* bread always possesses.

(1915.) *Leaven* was at first used to produce the fermentation spoken of in dough. It is nothing more than a piece of dough kept in a warm place until it undergoes a process of fermentation, swelling, becoming spongy, or full of air bubbles, at length disengaging an acidulo-spiritous vapour, and contracting a sour taste. A much better promoter of the panary fermentation is *yeast*, which is the viscid froth that rises on the surface of beer in the first stage of its fermentation.

(1916.) With good wheaten flour, the proportion given by the bakers to make bread is ¾ weight of flour and ¼ of yeast, water, and salt. The bread loses ⅛ of its weight in baking. With these proportions, a sack of flour of 280 lb. yields 92 loaves of 4 lb. each.

(1917.) It is not unusual for farmers to bake their household bread, and it may be done in this way: Take, say 24 lb. of flour, whether fine or ground overhead, and put it in a hollow clay dish. Make a deep hollow in the middle of it; and sprinkle a handful of salt over it. Then take ½ a pint of thick, sweet, fresh, well washed yeast, about 5 quarts of milk-warm water, from 65° to 70° Fahr., and a pint of bran, and stir them together in a pitcher. Too hot water will stop, and too cold will prevent fermentation. Pour the water and yeast over the flour through a sieve, and, mixing all lightly together, set the mass before the fire,

* Thomson's Organic Chemistry, *Vegetables*, p. 876.

covering it with a cloth. Light the oven fire, and bring it to a due heat. In about an hour the sponge will have risen sufficiently, when it should be kneaded with considerable force for about 15 or 20 minutes. The dough should not be worked too stiff, though it requires to be a little stiffer when the loaves are fired on their own soles than when fired in pans. The kneaded dough is again set before the fire, and covered with a cloth as before, when a new fermentation ensues, which will have proceeded far enough when the dough increases half more in bulk, that is, in about an hour, when the dough is portioned out into the size of the loaves desired, and placed in the oven to be fired. If the oven is too hot, the dough will be encrusted on the surface too much and too soon, and if too cold, the bread will be heavy, and not rise sufficiently in the firing. Experience must teach these particulars. This quantity will make 31 lb. of bread.

(1918.) The danger of making the bread *sour* is incurred between the first and second processes of fermentation. In the first it is the vinous fermentation, which of itself is innocent, but if increased heat is applied, or the sponge allowed to stand too long, it is apt to run into the acetous fermentation. This tendency is checked during the first process by kneading the dough in time. If, however, the second fermentation is allowed to continue longer than it should be, the acetous fermentation will rapidly appear, and then the bread will inevitably be sour unless some counteracting expedient is adopted, such as the application of an alkali, as carbonate of soda, or of an alkaline earth, as magnesia or chalk. It is certainly better to employ these neutralizing ingredients than to allow the batch of bread to become sour, but better still to use the means of making the batch into sweet bread than to rectify that acidity in it which ought never to have overtaken it; and the means of avoiding acidity are, to make the sponge fresh in the morning, a short time before the bread is to be fired, and not to allow it to stand over night in the kitchen, in a low temperature. I speak from experience, and can safely aver that with these precautions not a sour loaf was seen in my house for many years. I do not say that a sponge left over night *must* become sour, but only that it is much *more apt* to become so than when fresh made. When the second fermentation is allowed to proceed too far, both the lactic and acetic acids are formed; the former most sensibly affects the taste, and the latter the smell; and both combine to make bread sour.

(1919.) Brewer's barm makes the lightest and best *yeast* for family use, and what of it may not be used at one time may be kept sweet for some weeks in the following manner. "As this substance works out of the barrels, it should be placed in deep pans, and left to settle for a day or two. The thin fluid should then be poured off, and the pan filled with cold fresh spring water, stirring the thick yeast well up. Every day this operation is to be repeated, and occasionally it ought to be strained through a sieve into another vessel. It will thus always be ready for use." Experience alone can tell whether the scent or appearance of yeast procured at a brewery are those the most desirable; but these hints may prove useful. "If it be fit for the purpose, it will smell rather fragrant; if stale, it will have a strong acid, and slightly putrid scent. In this state, we have known it to be recovered and rendered available, by adding a tea-spoonful of flour, the same of sugar, a salt spoonful of salt, and a tea cupful of warm water, to a ½ pint of yeast, and setting it near the fire to rise, having well stirred it. This should be done about an hour before it is intended to be mixed with the flour; for that time is required in order to watch whether the fermentative principle is strong enough to work the bread. In a quarter of an hour, the mass will have nearly

reached its height, and a fine head will have formed. This must be looked at carefully. If it continue up and appear opaque, it may be trusted; but if it 'go back,' that is, sink, look hollow and watery, and the bubbles break, it will infallibly spoil the batch; it must be thrown away. *Bran ought always to be used*, however fresh and good the ferment may be found. Bran contains an acid principle which tends to subdue the bitter taste of the hop, and it also possesses much fermentative matter that assists the action of the yeast." In this way, "we have ourselves baked bread that was made with the barm from our own home-brewed beer for six successive weeks; not from necessity, but in order to ascertain the extent of time to which yeast might be kept sweet." *

(1920.) It is assumed by some people, that a mixture of potatoes amongst wheaten flour renders bread lighter and more wholesome. That it will render bread whiter, I have no doubt; but I have as little doubt that it will render it more insipid, and more than this, it is demonstrable that its use is less economical than wheaten flour. Thus, take a bushel of "seconds" flour, weighing 56 lb. at 5s. 6d. A batch of bread, to consist of 21 lb., will absorb as much water, and require as much yeast and salt, as will yield 7 loaves, of 4 lb. each, for 2s. 4d., or 4d. per loaf. "If, instead of 7 lb. of the flour, the same weight of raw potatoes be substituted, with the hope of saving by the comparatively low price of the latter article, the quantity of bread that will be yielded will be *but a trifle more than would have been produced from* 14 lb. *of flour only*, without the addition of the 7 lb. of potatoes; for the starch of this root is the only nutritive part, and we have proved that but $\frac{1}{7}$ or $\frac{1}{8}$ of it is contained in every pound, the remainder being water and innutritive matter. Only 20 lb. of bread, therefore, instead of 28 lb., will be obtained; and this, though white, will be comparatively flavourless, and liable to become dry and sour in a few days; whereas, without the latter addition, bread made in private families will keep *well* for 3 weeks, though, after a fortnight, it begins to deteriorate, especially in the autumn." The calculation of comparative *cost* is thus shewn:—

Flour, 14 lb., say at 1¼d. per lb., .	=	1s. 5½d.
Potatoes, 7 lb., say at 5s. per sack, .	=	0 2
Yeast and fuel, ...	=	0 4½
		2s. 0d.

The yield 20 lb., or 5 loaves of 4 lb. each, will be nearly 5d. each, which is dearer than the wheaten loaves, which were 4d. each, and the bread besides of inferior quality. "There are persons who assert—for we have heard them—that there is no economy in baking at home. An accurate and constant attention to the matter, with a close calculation of every week's results for several years—a calculation induced by the sheer love of investigation and experiment—enable us to assure our readers, that a gain is invariably made of from 1½d. to 2d. on the 4d. loaf. If *all* be entrusted to servants, we do not pretend to deny that the waste may neutralize the *profit*; but, with care and investigation, we pledge our veracity that the saving will prove to be considerable."† These are the observations of a notable housewife.

* Quarterly Journal of Agriculture, vol. ix. p. 290.

† Ibid. vol. ix. p. 584-9.

(1921.) The microscope has ascertained the *structure of wheaten flour.* "The largest grains of the fecula of wheat," says Raspail, "do not generally exceed .002 of an inch in size. They are spherical, and along with them we see empty and torn membranes, resulting from the bruising of the grains by the mill. They are much smaller, rounder, and better preserved, when they are extracted from the grain while it is greenish, and not ripened on the stalk." "Panification," he observes, "is a process, whose object is to burst all the grains of fecula, which are in the farina, associated with a very fermentable substance called gluten. The finest and best baked bread is what is made of farina abounding in an elastic gluten; for this gluten, rising in large blisters by the dilatation of the gases imprisoned within it, allows each feculent grain to participate in the communication of the heat, and to burst, as it would by boiling. Hence, after panification, if the paste has been well kneaded, we do not find a single grain of fecula entire. The bread will be duller and less properly baked, if it contains less of this gluten. This is the reason why, other circumstances being alike, the bread of rye and barley is less nourishing than that of wheat. Wheaten bread will likewise be heavier and less perfect, according as the flour has been more or less mixed with other grain or with fecula. It has been observed," he continues, "that the more of foreign fecula we mix with flour, the less increase of weight does the bread acquire. Thus, 6 lb. of flour produce 8 lb. of bread; but 3 lb. of fecula of the potato, with 3 lb. of flour, produce only 6 lb. of bread. The reason of this is the following:—The grains of fecula do not imbibe the water, but only are moistened by it; in other words, it only adheres to them. The gluten, on the other hand, imbibes it as a sponge would do, and the more it is kneaded the more it imbibes, and the water thus imbibed adds to the weight of the bread. There are two reasons, then, against this sort of mixtures; and this adulteration, though it be not a crime, is still a fraud, because the immediate result of it is to diminish at once the weight and the nutritive quality of the bread." Thus the minutest scientific research corroborates facts evolved by practice.

(1922.) *Wheat contains more gluten* than any of the other grains, and it is this substance which confers the relative value on wheat as an article of food. It is most developed when used in the form of bread. "If we prepare two masses of gluten by kneading," says Raspail, "we shall not be able to make them unite by simple contact; but if we tear open the side of each, and bring the edges together, the smallest effort will be sufficient to unite the two masses into one. The object of kneading, then, is to press the two edges of the glutinous parcels against each other. Hence the quantity of gluten will vary according to the mode of kneading employed. Thus Beccaria, who contented himself with placing the farina in a sieve, and keeping it under a stream of water, but without stirring it, obtained less gluten than Kesselmeyer, who, in the first place, made a paste of the farina, and then kneaded it continually under a stream of water, till the water ceased to pass off milky. In the former process, the weight of the water falling on the farina brought a few parcels together, but kept asunder or disunited the greater number, which consequently passed through the sieve. In the second process, on the contrary, the hand in kneading compressed, turned in every direction, and brought together by every point of contact, the scattered parcels, and scarcely allowed the water to carry off any thing but the round and smooth grains of fecula. I have ever found, that, in this process, we obtain

more or less gluten, according as the paste is pressed in different ways; for when it is merely compressed perpendicularly, we lose a good deal more of the gluten than when it is rolled upon itself with some force."

(1923.) In regard to the *nutritive properties of gluten*, there is no doubt they are of a superior order, though not for the reason ascribed by Magendie, who concluded that gluten is nutritious because sugar, which contains no nitrogen, could not support dogs in life beyond a certain time; while Parmentier was led to infer that gluten remains undigested. "But who does not perceive," justly asks Raspail, "that animals, till then accustomed to live on flesh, must suffer on being all at once deprived of this aliment, just as a horse would suffer from being fed on flesh instead of hay; for as digestion is a complex operation, why should we seek to study it by violating its elements? Sugar will not ferment by itself—why, then, expect that it should ferment without albumen in the stomach? If this mode of experimenting entitle us to erase sugar, oil, and gum from the list of nutritive substances, we must also erase pure gluten and even pure albumen; for if an animal be fed on them alone, it will die just as certainly as if it had been fed exclusively on sugar. This is one of those questions," he concludes, "in which both sides are wrong, and the truth lies in blending the opposite opinions together. Neither gluten nor sugar, taken singly, is nutritive; but they become alimentary when united."

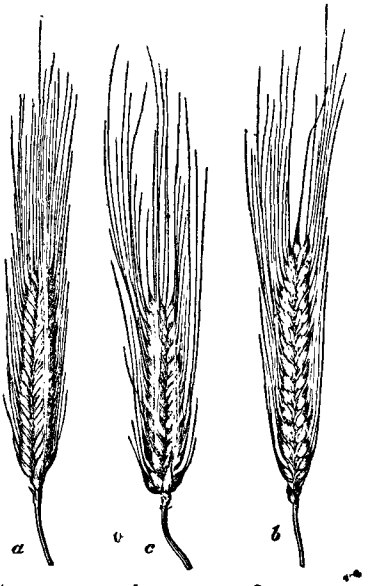
(1924.) Wheat is used in *starch*-making. "In starching linen," says Raspail, "the fecula of the potato, of the horse-chestnut, &c. may be used, as well as that of wheat; and it may be used either hot or cold, in the state of starch or of powder. The effect will be the same, provided the irons used be sufficiently heated. It is sufficient to mix the fecula with a little water, to dip the linen in it, clapping it with the hand, and to apply the hot iron while the linen is still moist. The grains of fecula will burst from the action of the heat, the membranes will dilate as they combine with a portion of the water that is present, the soluble mass will be freely dissolved in the rest of it, and the linen will be starched and dried by one process." Fecula is used in making size for paper as well as glue; and "it is known that weavers are obliged, in order to preserve the humidity of the *batter* used in dressing the threads, to work habitually in low, damp, and consequently unwholesome places. Dubuc, an apothecary at Rouen, proposed to add to the dressing a deliquescent chloride, which, by attracting the moisture of the air, might prevent the drying of the batter, and thus admit of the workman carrying on his labour in drier and more healthy places. Vergnaud recommends the use of the fecula of the horse-chestnut, which contains a proportion of potash sufficient to prevent the batter from drying."* "The wheat of the south of Europe, in consequence of the larger quantity of gluten it contains, is peculiarly fitted for making *macaroni* and other preparations of flour, in which a glutinous quality is considered as an excellence."† The macaroni is formed into different sized tubes, by the dough being pressed from a machine in broad fillets, the edges of which are brought into contact and adhere, while the dough is yet moist. Macaroni makes the finest flavoured dish with *Parmesan* cheese.

* Raspail's Organic Chemistry, pp. 114, 130, 182, 396.

† Davy's Lectures on Agricultural Chemistry, p. 136, edition of 1839.

(1925.) *Barley.*—Its botanical position is the 3d class Triandria, 2d order Digynia, genus Hordeum of the Linnean system; and in the natural order of the *Gramineæ*. Professor Low divides the cultivated barleys into two distinctions, namely, the 2-rowed and the 6-rowed, and each of these comprehends the ordinary, the naked, and the sprat or battledoor forms.* Mr Lawson describes 20 varieties of barley;† while the Museum of the Highland and Agricultural Society contains specimens of 30 varieties.‡ The natural classification of barley by the ear is obviously of 3 kinds, 4-rowed, 6-rowed, and 2-rowed. Fig. 360 represents the three forms, where *a* is the 4-rowed, or bere or bigg; *c* is the 6-rowed; and *b* the 2-rowed; all of which figures represent barley in half its natural size. Of these the bere or bigg was that which was cultivated until a recent period, when the 2-rowed has almost entirely supplanted it, and is now the most commonly cultivated variety, the 6-rowed being rather an object of curiosity than culture.

Fig. 360.



4-ROWED BERE OR BIGG. 6-ROWED BARLEY. 2-ROWED CHEVALIER BARLEY.

(1926.) In classifying barley by the *grain*, there are just two kinds, *bere* or *bigg*, and *barley;* and though both awned, are sufficiently marked to constitute distinct varieties. In the bere, the median line of the bosom is so traced as to give the grain a twisted form, one of its sides appearing larger than the other. In the barley the line passes straight, and divides the grain into two equal sides. They are both represented in fig. 361, where *a* is the bigg, with the twisted-like grain, and lengthened point from which the awn has been broken off; and *b* is the barley, whose shortness and plumpness give it a character of superiority. Both these clusters of grain are of the natural size. The bigg has long been recognised in Scotland, and even a 2-rowed variety, under the name of common or Scotch barley, has long been in cultivation; but several of the English varieties are now naturalized, and in their

Fig. 361.

ENGLISH BARLEY. SCOTCH BERE OR BIGG.

* Low's Elements of Practical Agriculture, p. 244.

† Lawson's Agriculturist s Manual, p. 33.

‡ Catalogue of the Museum, p. 60.

new sphere shew a brighter and fairer colour, plumper and shorter grain, quicker in the property of malting, though less hardy and prolific than the common barley. The crenulated or shrivelled skin across both sides of the median line in the English barleys is a good criterion of malting; and as most of the barley raised in this country is converted into beer or spirits, both of which require malt to produce them of the finest quality, it is not surprising that those varieties which yield the greatest return of malt should always realize the highest prices.

(1927.) A good crop of barley yields a return of from 48 to 60 bushels the imperial acre. Good barley weighs from 55 lb. to 59 lb. per bushel. A crop of 60 bushels per acre will yield of straw, in the vicinity of a town, 176 stones of 14 lb. to the stone, or $1\frac{1}{10}$ ton, and the weight of the grain of that crop, at 56 lb. per bushel, will be $1\frac{1}{2}$ ton. It takes of bigg 111 grains to weigh 1 drachm; of 6-rowed barley, 93; and of Chevalier barley, 80 grains. Of the three kinds, the Chevalier is much the heaviest.

(1928.) By far the largest proportion of the best barley grown in this country is converted into *malt* for making malt liquor and spirits, and barley is also used for distillation in a raw state. In three years, the following quantities of malt paid duty, viz.:—

	ENGLAND.	SCOTLAND.	IRELAND.	TOTAL.
	Bushels.	Bushels.	Bushels.	Bushels.
1834,	34,949,646	3,580,758	1,776,883	40,307,287
	L.4,449,745	L.462,514	L.229,514	L.5,141,775
1835,	36,078,855	3,604,816	1,825,300	41,508,971
	L.4,660,185	L.465,622	L.235,767	L.5,361,574
1836,	37,196,998	4,168,854	1,872,104	43,237,956
	L.4,804,612	L.538,477	L.241,813	L.5,584,902

Pot and pearl barley are made from barley for culinary purposes; and both meal and flour are manufactured from barley for the purpose of making unleavened bread, which is eaten by the labouring class in some parts of the country, and barley bannocks are esteemed a luxury by people in towns. Porridge of barleymeal, with rich milk, is accounted a pleasant and light supper, and less heating than that of oatmeal.

(1929.) The *barley has received great attention from the chemist*, both on account of its importance as a fermentable substance, and partly to discover its constituent parts. "The following are the proportions of the constituents obtained by Einhoff from 3840 parts of barley-corns:—

Volatile matter, ...	430
Husk, ...	720
Meal, ...	2690
	3840

From the same quantity of barleymeal he obtained,—

Volatile matter,	360
Albumen,	44
Saccharine matter,	200
Mucilage,	176
Phosphate of lime, with some albumen,	9
Gluten,	135
Husk, with some gluten and starch,	260
Starch, not quite free from gluten,	2580
Loss,	76
	3840

Besides these substances, Fourcroy and Vauquelin ascertained the presence of phosphates of lime and magnesia, and of silica and iron; and I found in it phosphate of potash and nitrate of soda. Barleymeal, on being macerated, yields an oil, which is supposed to give its peculiar flavour to spirits from raw grain. If this opinion is well founded, the oil must be dissipated or destroyed by the process of malting."*

(1930.) The grains of the fecula of the barley are very fine, not exceeding .00098 of an inch in size. Barley-flour only contains 3 per cent. of gluten, and is therefore much less nutritive than wheaten flour. The *hordein*, ascribed by Proust to act so important a part in the germination of barley, is asserted by Raspail to be nothing more, under the microscope, than bran. "That this is the case," he says, "is proved by dissection; for if we make a transverse slice of each of the grains of wheat and barley, we shall perceive that the pericarp of the wheat peels off entire like a circular band, while that of the barley can only be detached in very small fragments. Now, what takes place, under the edge of the scalpel," he alleges, "will also happen under the pressure of the millstone; consequently, the bran will be much more minutely divided in the farina of barley than in that of wheat. In boulting flour, therefore, it will remain in the sieve; while, in the other, its almost microscopic fragments will pass through with the fecula and gluten, and will be almost inseparable, by mechanical means, from the farina." Hence, if pearl barley "be ground, we obtain from it a farina as white as that of wheat, and containing only a very minute portion of hordein, equivalent to the amount of those fragments of the pericarp which had been protected by their situation in the posterior groove of the grain." †

(1931.) "The meal so highly commended by the Greeks was prepared from barley. . . . It was not until after the Romans had learnt to cultivate wheat and to make bread, that they gave barley to the cattle. They made barleymeal into balls, which they put down the throats of their horses and asses, after the manner of fattening fowls, which was said to make them strong and lusty. Barley continued to be the food of the poor, who were not able to procure better provision; and in the Roman camp, as Vegetius has informed us, soldiers who had been guilty of any offence were fed with barley instead of bread corn." ‡

(1932.) *Malting.*—This process produces a considerable change in the con-

* Thomson's Organic Chemistry, *Vegetables*, p. 882.

† Raspail's Organic Chemistry, p. 120, 206.

‡ Phillips' History of Cultivated Vegetables, vol. i. p. 50.

stitution of the grain. The barley is steeped in cold water for at least 40 hours, according to law. Here it imbibes moisture, increases in bulk, and emits a quantity of carbonic acid gas, not exceeding 2 per cent. The moisture imbibed is 0.47, that is to say, every 100 lb. of barley, when taken out of the steep, weighs 147 lb. The increase of bulk is $\frac{1}{5}$, that is, 100 bushels of grain measures out 120 bushels. The steep water dissolves from $\frac{1}{50}$ to $\frac{1}{100}$ of the husk of the barley, and hence barley becomes paler by steeping. The steeped barley is then put on a floor in a heap 16 inches deep, to remain so for 26 hours. It is then turned with wooden shovels, and diminished in depth to a few inches by repeated turnings. In 96 hours the grain becomes 10° hotter than the air, and then *sweats*, when it is frequently turned, the temperature being preserved in the grain from 55° to 62°. The roots now begin to appear, the stem called *acrospire*, springs from the same end, and advances within the husk to the other end of the grain; but the process of malting is stopped by kiln-drying before the germ has made much progress. The kiln, at first 90°, is raised gradually to 140°. The malt is then cleaned, and the rootlets removed, as they are considered injurious, and are called *comins*. Malt is from 2 to 3 per cent. greater in bulk than the barley, and it loses $\frac{1}{5}$ or 20 per cent. in weight, of which 12 per cent. is loss by drying; so the real loss is only 8 per cent., accounted for by the steep water carrying away $1\frac{1}{2}$ per cent., dissipated on the floor 3 per cent., roots cleaned away 3 per cent., and waste $\frac{1}{2}$ per cent. The roots take away the glutinous portion of the grain, and the starch is converted into a sort of sugar.

(1933.) *Beer.*—Beer is a beverage of great antiquity. "The earliest writer who mentions *beer*," commences Dr Thomson in his account of the process of malting, of which the foregoing paragraph is the substance, "is Herodotus, who was born in the first year of the 74th Olympiad, or 444 years before the commencement of the Christian era. He informs us that beer was the common drink of the Egyptians, and that it was manufactured from barley, because vines did not grow in their country. In the time of Tacitus, whose treatise on the *Manners of the Germans* was written about the end of the first century of the Christian era, beer was the common drink of the Germans. Pliny mentions beer as employed in Spain, under the names of *cælia* and *ceria*, and in Gaul under the name of *cervisia*. Almost every species of corn has been used in the manufacture of beer. In Europe it is usually made from *barley*, in India from *rice*, in the interior of Africa, according to Park, from the seeds of the *Holcus spicatus*. But whatever grain is employed, the process is nearly the same, and it is usual in the first place to convert it into malt." *

(1934.) *Oats.*—Oats are cultivated on a large extent of ground in Scotland, and it is believed that no country produces greater crops of them or of finer quality. The plant belongs to the natural order of *Gramineæ*, and it occupies the 3d class *Triandria*, 2d order *Digynia*, genus *Avena*, of the Linnæan system. Its ordinary botanical name is *Avena sativa*, or cultivated oat. The term oat is of obscure origin. Paxton conjectures it to have been derived from the Celtic *etan*, to eat.† There are a great number of varieties of this grain cultivated in this country. Mr Lawson describes 37; ‡ and 54 are deposited in the Highland and Agricultural Society's Museum. § The natural classification of

* Thomson's Organic Chemistry—*Vegetables*, p. 1011–12.

† Paxton's Botanical Dictionary, art. *Avena*.

‡ Lawson's Agriculturist's Manual, p. 44.

§ Catalogue of the Museum, p. 59.

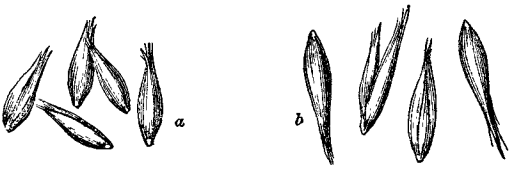
this plant by the *ear* is obvious. One kind has its panicles spreading and equal on all sides, and tapering towards the top of the spike in a conical form. The other

Fig. 362.

THE TARTARIAN OAT. THE POTATO OAT.

has its panicles shortened, nearly of equal length, and all on the same side of the rachis. Fig. 362 represents both the kinds, *a* shewing the first, and *b* the se-

Fig. 363.



THE POTATO OAT. THE WHITE SIBERIAN EARLY OAT.

cond, where they both appear somewhat confined or squeezed towards the rachis, the object being to exhibit the grain in the straw as taken from the stack, rather than when pulled green from the field. *a* is the prolific potato oat, which is

beardless, commonly cultivated in Scotland for the sake of its meal; and *b* is the white Tartarian oat, which is bearded, and extensively cultivated in England for horse-corn. The natural classification by the *grain* consists also of two forms; the one a round plump grain like *a*, fig. 363, and an elongated thin grain, having a tendency to shew awns, as at *b*; the *a* kind being cultivated on the best lands in the low country, the other on poorer soils and in high districts. The first is tender, and liable to shake with the wind; the other is hardy, and able to resist the tempest. The former is cultivated chiefly for human food, yielding meal largely, the latter being raised chiefly for the food of horses. The straw of the former kind is strong and inclined to reediness; that of the latter is fine, pliable, and makes an excellent dry fodder for cattle and horses, there being a good deal of saccharine matter in the joints; the former is considered late in coming to maturity, the latter early, and is consequently so designated.

(1935.) The *crop* of oats varies from 40 to 75 bushels per imperial acre, according to the kind, and the circumstance of soil and situation. Oats vary in weight from 36 lb. to 48 lb. per bushel. Whiteness, of a silvery hue, and plumpness, are the criterions of a good sample. The potato-oat, 47 lb. per bushel, gave 134 grains to 1 drachm; the Siberian early oat, weighing 46 lb. per bushel, gave 109 grains; and the white Tartarian oat gave 136 grains. A crop of potato-oats, yielding 60 bushels to the acre, at 47 lb. per bushel, will weigh of grain 1 ton 5 cwt. 20 lb., and will yield of straw 1 ton 5 cwt. 16 lb., in the neighbourhood of a large town; or, in other words, will yield 8 kemples of 40 windlings each, and each windling 9 lb. in weight. But I have been made acquainted with a crop of Hopetoun oats near Edinburgh of no more than 60 bushels to the imperial acre, yielding 2 tons 18 cwt. 16 lb. of straw. The common oats yield more straw in proportion to the grain than the potato variety.

(1936.) The portion of the oat-crop consumed by man is manufactured into *meal*. It is never called flour, as the millstones are not set so close in grinding it as when wheat is ground, nor are they usually made of the same material, but most frequently of sandstone. Oats, unlike wheat, are always kiln-dried before being ground; and they undergo this process for the purpose of allowing the thick husk, in which the substance of the grain is enveloped, to be ground off, which it is by the stones being set asunder; and the husked grain is then winnowed by fanners, which blow away the husk and retain the grain, which is then called *groats*. The groats are ground by the stones closer set, and yield the meal. The meal is then passed through sieves to separate the remaining husk from the meal. The meal is made in two states; one *fine*, which is the state best adapted for making into bread, in the form called oat-cake or bannocks; and the other is coarser or *rounder* ground, and is in the best state for making the common food of the country people, porridge, *Scotice*, parritch. A difference of practice prevails in respect to the use of these two different states of oatmeal in different parts of the country, the fine meal being best liked for all purposes in the northern, and the round or coarse meal in the southern counties; but as oat-cake is chiefly eaten in the north, the meal is there made to suit the purposes of bread rather than of porridge; whereas, in the south, bread is made from another grain, and oatmeal is there used only in the shape of porridge. There is no doubt that the round meal makes the best porridge when properly made, that is, when boiled as long as to allow the particles to swell and burst, when the porridge becomes a pultaceous mass. So made, with rich milk or cream, there are few more wholesome meals for any man,

or upon which a harder day's work can be wrought. Children of all ranks in Scotland are brought up on this diet, verifying the poet's assertion,

" The halesome parritch, chief o' Scotia's food."—BURNS.

(1937.) In regard to the *yield of meal* from any given quantity of oats, it is considered that when they give what is called *even meal* they yield half their weight of meal; that is, supposing that a boll of oats of 6 bushels weighs 16 stones, it should give 8 stones of meal, and, of course, 8 stones of refuse; but the finer class of oats will give more meal in proportion to weight than this, more nearly 9 stones, and some even 12 stones. The market value of oats are thus estimated by the meal they are supposed to yield, and in discovering this property in the sample millers become very expert. When oats yield less than even meal they are considered to give ill, and are disposed of for horses, or kept at home for that purpose.

(1938.) The *oat* has *not* received that attention from the *chemist* as the barley or wheat. The principal characteristic of oatmeal is, that it contains a large proportion of starch. " Vogel found that 100 parts of oats consisted of meal 66, and of husk 34. The dry meal yielded

Fat yellowish-green oil,	2
Bitter extract and sugar,	8.25
Gum,	2.5
A grey substance like albumen,	4.3
Starch,	59.0
Moisture and loss,	23.95
	100.00"*

" The farina of the oat seems, to the unassisted eye, cottony, or as it were felted, from the presence of an innumerable quantity of hairs with which the seeds are covered. The grains of the fecula have a size of about .00276 by .0018 of an inch. They appear in general yellowish, and strongly shaded. Some of these have the appearance, but not the form, of the fecula of the potato."†

(1939.) " We find no mention made of oats in Scripture," says Phillips, " which expressly states that Solomon's horses and dromedaries were fed with barley;" but " the use of oats as a provender for horses appears to have been known in Rome as early as the Christian era, as we find that that capricious and profligate tyrant Caligula fed *Incitatus*, his favourite horse, with *gilt oats* out of a golden cup." Oats are mixed with barley in the distillation of spirits from raw grain; and " the Muscovites make an ale or drink of oats, which is of so hot a nature, and so strong, that it intoxicates sooner than the richest wine."‡

(1940.) *Rye.*—Botanically, this plant occupies the same place, both in the natural and sexual systems, as the other grains which have been described. It is the *Secale cereale* of the botanists, so called, it is said, *à secando*, from cutting, as opposed to leguminous plants, whose fruits used to be gathered by the hand. A figure of the spike of rye may be seen at *e*, fig. 358. It is a narrow small grain,

* Thomson's Organic Chemistry—*Vegetables*, p. 880.

† Raspail's Organic Chemistry, p. 113.

‡ Phillips' History of Cultivated Vegetables, p. 9.

not unlike shelled oats. There is only one known species of this plant, which is said to be a native of Candia, and was known in Egypt 3300 years ago; but there are several varieties which are raised as food, 4 of which are described by Mr Lawson,* and 7 to be seen in the Museum of the Highland and Agricultural Society.† The produce of rye may be about 24 bushels per acre, and the weight of the grain is stated at from 52 lb. to 57 lb. per bushel; the number of grains in 1 drachm weight being 165.

(1941.) The rye is not much cultivated in this country, particularly in Scotland, where only a patch here and there is to be seen. It is, however, extensively cultivated on the Continent, especially in sandy countries, and indeed forms the principal article of food of the labouring classes. I have been in many parts of Germany where none but rye-bread could be purchased. Rye-bread is denser than wheaten-bread, and darker in colour, and, when baked in the sweet state, is rather agreeable to the palate; but when baked sour, in which state it is commonly used in many places, it requires custom to make one become reconciled to its taste. Horses on the Continent get it on a journey in lieu of corn, and seem very fond of it.

(1942.) Eienhoff analyzed rye-seeds and meal with great care: 3340 parts of good rye-seeds were composed of

Husk,	930
Moisture,	390
Pure meal,	2520
	3840

100 parts of good rye-meal contained

Albumen,	3.27
Gluten, not dried,	9.43
Mucilage,	11.09
Starch,	61.09
Saccharine matter,	3.27
Husk,	6.33
Loss,	5.42
	100.00

"But the proportion of these substances must vary extremely according to the soil, the climate, and the age of the rye. The gluten of rye differs in several particulars from that of wheat. It is less tenacious and more soluble. When it was allowed to ferment, Einhoff perceived a strong smell of nitric acid, which is peculiar to this species of gluten. The starch of rye bears a striking resemblance to that of wheat. Like this last, it does not form a colourless solution with boiling water, and always precipitates at last, when the solution is left a sufficient time to rest."‡

(1943.) The grains of the fecula of rye meal are peculiarly shaped. "The largest grains of this fecula," says Raspail, "are about .002 of an inch in size; but what distinguishes them from all the other varieties is, that they are flat-

* Lawson's Agriculturist's Manual, p. 31.

† Catalogue of the Museum, p. 62.

‡ Thomson's Organic Chemistry, *Vegetables*, p. 878.

tened, and with sharp edges like discs, and, for the most part, marked on one of their sides with a black cross, or three black rays united at the centre of the grain."*

(1944.) *Beans.*—Beans belong to a very different tribe of plants to those we have been considering. They belong to the natural order of *Leguminosæ*, because they bear their fruit in legumes or pods; and in the Linnæan system they occupy the class and order *Diadelphia decandria*. Their generic term is *Faba vulgaris;* formerly they were classed amongst the vetches and called *Vicia Faba*. The common bean is divided into two classes, according to the mode of culture to which they are subjected, that is, the field or the garden. Those cultivated in the field are called *Faba vulgaris arvensis*, or as Loudon calls them, *Faba vulgaris equina*, because they are cultivated chiefly for the use of horses, and are usually termed horse-beans. The garden bean we have nothing to do with, though some farmers attempt some of the garden varieties in field culture, but I believe without success. All beans have butterfly or papilionaceous flowers. Mr Lawson has described 8 varieties of the field bean; and 10 varieties are placed in the Highland and Agricultural Society's Museum.† The variety in common field-culture is thus well described by Mr Lawson. "In length the seed is from ½ to ⅝ of an inch, by ⅜ in breadth, generally slightly or rather irregularly compressed and wrinkled on the sides, and frequently a little hollowed or flattened at the end; of a whitish or light brown colour, occasionally interspersed with darker blotches, particularly towards the extremities; colour of the eye black. Straw from 3 to 5 feet in length. There is perhaps," continues Mr Lawson, "no other grain over the shape and colour of which the climate, soil, and culture, exert so much influence as in the bean. Thus, in a dry warm summer and harvest, the sample is always more plump and white in colour than in a wet and cold season; and these more so in a strong rich soil than in a light, and more so in a drilled crop than in one sown broadcast."‡ I omitted to mention in the proper place, under the head of our subject of barn-work, that, as the bean is easily separated from its pod, the fast motion of the thrashing-machine should be put on when beans are to be thrashed, and in case, even with the fast motion, the straw, being brittle, should be much broken, the best plan to avoid this effect is to feed the sheaves thin *sideways*, instead of lengthways, into the feeding-rollers. The pods being covered with a sort of down, which becomes black on winning the crop, the thrashing throws off this down like a thick black impalpable dust, which, entering the mouth and nostrils and blackening the clothes, makes the thrashing of beans a disagreeable process; and the noise occasioned by their impinging against the iron lining of the drum-case, is almost deafening, and almost overpowering to human speech.

(1945.) The produce of the bean crop varies from 20 to 40 bushels per imperial acre, much of the prolificacy of the crop depending on the nature of the season. The average weight may be stated at 66 lb. per bushel. It only requires 5 beans to weigh 1 drachm. I have not cultivated the bean so much as to enable me to ascertain the weight of a good crop of straw or haulm, in compa-

* Raspail's Organic Chemistry, p. 116.

† Catalogue of the Museum, p. 68.

‡ Lawson's Agriculturist's Manual, p. 62.

rison with that of the grain, for it is seldom that the same season gives the largest return of both; but I have seen it stated, that "it has been known to yield 2 tons per acre."* A crop of 40 bushels, at 66 lb. per bushel, gives 1 ton 3 cwt. 64 lb. per acre.

(1946.) Beans are administered to the horse either raw whole, or boiled whole or bruised. They are given to cattle in the state of meal, that is, husk and grain ground overhead, and that not very finely. Beans, however, can be ground into fine flour; and in this state is used to adulterate the flour of wheat. Its presence is easily detected by the peculiar smell arising from the flour when warm water is thrown upon it. Beans are of essential service to support horses that have fatiguing work. "If beans do not afford more nutriment," says Stewart, "weight for weight of oats, they at least produce more lasting vigour. To use a common expression, they *keep the stomach longer*. The horse can travel farther; he is not so soon exhausted. . . . In the coaching stables, beans are almost indispensable to horses that have to run long stages. They afford a stronger and more permanent stimulus than oats alone, however good. Washy horses, those of slender carcass, cannot perform severe work without a liberal allowance of beans; and old horses need them more than the young. The quantity varies from 3 to 6 lb. per day; but in some of the coaching stables the horses get more, 1 lb. of oats being deducted for every 1 lb. of beans. Cart-horses are often fed on beans, to the exclusion of all other corn, but they are always given with dry bran, which is necessary to keep the bowels open, and to ensure mastication, and for old horses they should be always broken." "There are several varieties of the bean in use as horse-corn; but I do not know that one is better than another. The small plump bean is preferred to the large shrivelled kind. Whichever be used, the bean should be old, sweet, and sound; not mouldy, nor eaten by insects. New beans are indigestible and flatulent; they produce colic, and founder very readily. They should be at least a year old." †

(1947.) Einhoff carefully analyzed the small field-bean. "From 3840 parts of the ripe beans, he obtained the following substances:—

Volatile matter,	600
Skins,	386
Starchy fibrous matter,	610
Starch,	1312
Vegeto-animal matter,	417
Albumen,	31
Extraction, soluble in alcohol,	136
Gummy matter,	177
Earthy phosphate,	37½
Loss,	133½
	3840

Vaquelin could detect no sugar in it. He and Cornea de Serra found in the *skins* of the bean, *tannin* striking a blue with the persalts of iron, *animo-vegetable matter* mixed with tannin, insoluble in water, but soluble in potash. The

* British Husbandry, vol. ii. p. 215.

† Stewart's Stable Economy, p. 205–6.

cotyledons contained a sweet-tasted substance, starch, legumen, albumen, an uncombined acid, with carbonate of potash, phosphates of lime, magnesia, and iron. The *germen* of the bean contained white tallow, legumen, albumen, phosphate of lime, and iron."*

(1948.) The grains of the fecula of the bean "are egg or kidney shaped, often presenting an interior grain, as if inclosed in the principal one. Some of them are found broken down and empty. They attain the size of .002 of an inch."†

(1949.) The ancients entertained some curious notions in regard to the bean. The Egyptian priests held it a crime to look at beans, judging the very sight unclean. But the bean was not everywhere thus contemned, for Columella notices them in his time as food for peasants, and for them only.

"And herbs they mix with beans for vulgar fare."

"The Roman husbandmen had a religious ceremony respecting beans somewhat remarkable: When they sowed corn of any kind, they took care to bring some beans from the field for good luck's sake, superstitiously thinking that by such means their corn would return home again to them. The Romans carried their superstition still farther, for they thought that beans, mixed with goods offered for sale at the ports, would infallibly bring good luck to the seller." They used them, however, more rationally, when beans were employed "in gathering the votes of the people, and for electing the magistrates. A *white* bean signified absolution, and a *black* one condemnation. From this practice, we imagine, was derived the plan of *black-balling* obnoxious persons."‡ It would appear, from what Mr Dickson states, that the *faba* of the Romans, a name, by the way, said to be derived from *Haba*, a town of Etruria, where the bean was cultivated, is the same as the small bean of our fields.§

(1950.) *Pease.*—The pea occupies a similar position in both the natural and artificial systems of botany, as the bean. The plant is cultivated both in the field and in the garden, and in the latter place to great extent and variety. The *natural* distinction betwixt the field and garden pea is found in the flower, the field pea always having a red-coloured, and the garden pea almost always a white flower; at least the exceptions to this mark of distinction are few. The botanical name of the pea is *Pisum sativum*, the cultivated pea, and those varieties cultivated in the field are called in addition *arvense*, and those in the garden *hortense*. The name is said to have been given to it by the Greeks, from a town called Pisa, in Elis, in the neighbourhood of which this pulse was cultivated to great extent.‖ Mr Lawson has described 9 varieties of the field pea, and the Highland and Agricultural Society's Museum contains 14 varieties.‖ Of these there is a late and an early variety cultivated, the late kind, called the *common grey field-pea*, or *cold-seed*, is suited for strong land in low situations, and the early, the *partridge*, *grey maple*, or *Marlborough pea*, is suited for light soils and late situations, and it is superseding the old grey Hastings, or *hot-seed* pea. The grey pea is described as having "its pod

* Thomson's Organic Chemistry, *Vegetables*, p. 887.

† Raspail's Organic Chemistry, p. 116.

‡ Phillips' History of Cultivated Vegetables, vol. i. p. 67-8.

§ Dickson's Husbandry of the Ancients, vol. ii. p. 182-4.

‖ Catalogue of the Museum, p. 68.

semi-cylindrical, long, and well filled, often containing from 6 to 8 peas. The ripened straw indicates 3 varieties—one spotted with a bluish-green ground, one light blue, and one bluish green without spots." The partridge pea has its " pods broad, and occasionally in pairs, containing from 5 to 7 peas, of a medium size, roundish, and yellowish-brown speckled, with light-coloured eyes. The ripe straw is thick and soft like, leaves large and broad, and average height 4 feet."*

(1951.) The produce of the pea-crop is either in abundance or a complete failure. In warm weather, with occasional showers, the crop may amount to 46 bushels, and in cold and wet, it may not reach 12 bushels the acre. The grain weighs 64 lb. the bushel, and it gives 13 grains to 1 drachm. In thrashing it, the feeding rollers are put on the fast motion, and the sheaf is allowed to be taken in by them, while the feeder holds on by the sheaf, and pulls it thinner and thinner. Peas are as easily thrashed out as beans; but the process does not create such an offensive dust, though the noise attending it is very great. Peas are riddled with the oat riddle, the refuse generally being small clods of earth and shrivelled grains, which are left in the riddle, and given to the pigeons.

(1952.) Chemists have examined the pea. "From ripe peas, by macerating them in water, and employing a mode of analysis similar to that used in ascertaining the constituents of barley, Einhoff obtained the following products; the quantity employed was 3840 parts:—

Volatile matter,	540
Starchy fibrous matter, with the coats of the peas,	840
Starch,	1265
Animo-vegetable matter,	559
Albumen,	66
Saccharine matter,	81
Mucilage,	249
Earthy phosphates,	11
Loss,	229
	3840"

In regard to the substance named *animo-vegetable matter*, " it approaches most nearly to gluten; but as it differs in several particulars from gluten and from all other vegetable constituents, we must consider it as a peculiar principle." "When dried, it assumes a light-brown colour, and the semi-transparency of glue, and is easily reduced to powder. Einhoff remarks that he has seen the gluten of wheat assume this appearance. I have observed the same thing," says Dr Thomson, " twice. In both cases the wheat was very inferior in quality, and had been the growth of a very rainy season." †

(1953.) " The grains of the fecula of the pea are nearly of the same size as those of the bean, and of the form of those of the potato. When fresh they are as strongly shaded at the edges as those of the bulbs of the *Alstrœmeria pele-*

* Lawson's Agriculturist's Manual, p. 70.

† Thomson's Organic Chemistry, *Vegetables*, p. 885.

grina. Their surface is unequal. The largest of them is about .002 of an inch."*

(1954.) The pea was formerly much cultivated in this country in the field, and even used as food, both in broth and in bread, *pease bannocks* having been a favourite food of the labouring class; but since the extended culture of the potato its general use is greatly diminished. It is now chiefly given to horses, but is also split for domestic purposes, such as making pea-soup,—a favourite dish with families in winter. Its flour is used to adulterate that of the wheat, but is easily detected by its peculiar smell, which is given out with hot water. Peas-meal in brose is administered in some cases of dyspepsia. Peas-pudding is eaten as an excellent accompaniment to pickled pork. It used to be customary in the country to burn a sheaf of peas, by which the peas were roasted, and, when mixed with butter and served up while hot at supper, were eaten as a treat under the name of *carlins.* In some towns where ancient customs still linger, roasted peas are sold in winter in the hucksters' stalls. Pigeons are excessively fond of the pea, and I have heard it alleged, that they can eat their own weight of them every day. "The ancients gave peas to stallion horses, on account of a particular virtue which they were thought to possess."†

(1955.) These are the *constituents* in 100 lb. of the *ashes* of the different sorts of grain we have been treating of. Instead of giving the constituents of each separately, I have collected them together, in order to shew their comparative proportions :—

Constituents in	Wheat.	Barley.	Oats.	Rye.	Beans.	Pease.
	lb.	lb.	lb.	lb.	lb.	lb.
Potash,	19	12	6	51	19½	32¾
Soda,	20½	12	5		38¼	30
Lime,	8	4½	3	10¾	7¾	2½
Magnesia,	8	8	2½	4½	7¼	5½
Alumina,	2	1	0½	2½	1½	0¾
Oxide of iron,	—	a trace	1½	4	—	0½
Oxide of manganese,	—	—	—	3½	—	—
Silica,	34	50	76½	15¾	6	16½
Sulphuric acid,	4	2½	1½	2½	4¼	2¼
Phosphoric acid,	3½	9	3	4½	13¾	7¾
Chlorine,	1	1	0½	1	1¾	1½
	100	100	100	100	100	100

On comparing the numbers in these columns we may observe how much more potash peas contain compared to beans; how beans contain double the quantity

* Raspail's Organic Chemistry, p. 116.

† Phillips' History of Cultivated Vegetables, vol. ii. p. 48.

of soda to that of potash; how there is as much magnesia as lime in the bean: how large a quantity of the oxides of iron and manganese are found in rye compared to all the rest of the grains; how large a proportion of silica the oat contains in comparison of the rest of the grains; and how large a proportion of phosphoric acid the bean contains to other grains. The following statement exhibits the *weight of ashes* left by 100 lb. of the sorts of grain spoken of above, according to the analysis of Sprengel:—

The grain of wheat leaves	. .	1.18 lb. per cent. of ash.	
... barley	... . . .	2.35	... ...
... ...	... dried at 212°,	2.52	... ...
... oats	... . . .	2.58	... ...
... beans	... . . .	2.14	... ...
... peas	... . . .	2.46	... ...*

(1956.) *Straw.*—As the straw of the various kinds of grain which I have just treated of possess different properties, and as they are *best* applied to different purposes, a few remarks on their peculiarities may be useful.

(1957.) *Wheat-straw.*—Wheat-straw is generally long. I have seen it upwards of 6 feet in length in the Carse of Gowrie, and it has always strength, whatever may be its length. Of the two sorts of wheat, white and red, the straw of white wheat is softer, more easily broken by the thrashing-mill, and more easily decomposed in the dunghill. Red wheat-straw is tough. The straw of some sorts of wheat of both kinds possess their respective properties in a greater and less degree than others. The strength and length of wheat-straw render it useful in thatching, whether houses or stacks. It is yet much employed in England for thatching houses, and perhaps the most beautiful thatchers are to be found in the county of Devon. Since the general use of slates in Scotland, the thatching of houses with straw has almost fallen into desuetude in that country. An existing thatch-roof may yet be repaired in preference to the adoption of a slated one, but no new roof is thatched with straw. Wheat-straw makes the best thatching for corn-stacks, its length and straightness insuring safety, neatness, and dispatch in the process, in the busy period of securing the fruits of the earth. It forms an admirable bottoming to the bedding in every court and hammel of the steading. As littering-straw, wheat-straw possesses superior qualities. It is not so suited for fodder to stock, its hardness and length being unfavourable to mastication; yet I have seen farm-horses very fond of it. Horses in general are fond of a hard bite, and were wheat-straw cut for them by the chaff-cutter of a proper length, I have no doubt they would prefer it to every other kind of straw as fodder. The *chaff* of wheat does not seem to be relished by any stock; and is therefore strewn on the dunghill, or upon the lairs of the cattle within the sheds. When it ferments, it causes a great heat, and on this account I have supposed that it would be a valuable ingredient in assisting to maintain a heat around the frames of forcing pits. The odour arising from wheat-straw and chaff fresh thrashed is glutinous.

(1958.) *Barley-straw* is always soft, and has a somewhat clammy feel, and its odour, with its chaff, when new thrashed, is heavy and malt-like. It

* Compiled from Johnston's Elements of Agricultural Chemistry, p. 46, and Lectures on Agricultural Chemistry, pp. 260 and 318-21.

is relished by no sort of stock as fodder; on the contrary, it is said to be deleterious to horses, on whom its use is alleged to engender grease in the heels. Barley-chaff, however, is much relished by cattle of all ages, and rough as the awns are, they never injure their mouths in mastication. Barley-straw is thus only used as litter, and in this respect it is much inferior to wheat-straw either for cleanliness, durability, or comfort. It does not make a good thatch for stacks, being too soft and difficult to assort in lengths, apt to let through the rain, and rot. Barley-chaff soon heats in the chaff-house, and if not removed in the course of two or three days, dependent on the state of the air, decomposition will rapidly ensue. Barley-straw and chaff seem to contain some active principle of fermentation.

(1959.) *Oat-straw.*—This straw is most commonly used as fodder, being considered too valuable to be administered in litter. It makes a sweet soft fodder, and, when new thrashed, its odour is always refreshing. Its chaff is not much relished by cattle. Oat-straw is very clean, raising little or no dust, and so is its chaff; and on this account, as well as its elasticity, the latter is very commonly used in the country to make beds with tickings, for which purpose the chaff is riddled through an oat-riddle, and the larger refuse left in the riddle thrown aside. Sheep are very fond of oat-straw, and will prefer it to bad hay; and even on the threatening of a coming storm, when on turnips, I have seen them prefer it to good hay. Of the different sorts of oat-straw, that of the common oats is preferred, being softer, sweeter, and more like hay than that of the potato-oat. When oats are cut a little green, the straw is much improved as fodder.

(1960.) *Rye-straw.*—This kind of straw is small, hard, and wiry, quite unfit for fodder, and perhaps would make but uncomfortable litter in a stable, though it would, no doubt, be useful in a court for laying a durable bottoming for the dunghill; but it forms most beautiful thatch for houses, and would, of course, do for stacks, if it were not too expensive an article for the purpose. It is much sought for by saddlers for stuffing collars of posting and coach-horses, and in default of this wheat-straw is substituted. It is also in great request by brick-makers, who, as stated by a writer, gave as much as L.5 per load for it in the neighbourhood of London in the winter of 1834–5, but from what particular reason is not mentioned.* Its ordinary price is L.2 per load. The plaiting of rye-straw for hats was practised so long ago as by even the ancient Britons, and was certainly not out of use in Shakspeare's days, who thus notices the custom of wearing this elegant head-gear on holidays:—

> "You sun-burned sicklemen, of August weary,
> Come hither from the furrow, and be merry;
> Make holy-day; your rye-straw hats put on,
> And then fresh nymphs encounter every one
> In country footing."
>
> THE TEMPEST.

I have seen very useful hats and bonnets for field-work made by labourers and field-workers from the upper joint of wheat-straw. Bee-hives and *ruskies*—that is, baskets for supplying the sowers with seed—are beautifully and lightly made of rye-straw; but where that commodity is scarce, which it usually is in Scotland, wheat-straw is substituted.

* British Husbandry, vol. ii. p. 170.

(1961.) *Pease and Bean-straw, or haulm.*—It is difficult in some seasons to preserve the straw of the pulse crops, but, when properly preserved, there is no kind of straw so great a favourite as fodder with every kind of stock. An ox will eat pease-straw as greedily as he will hay; and a horse will chump bean-straw with more gusto than ill-made rye-grass hay. Young cattle are exceedingly fond of bean and pease chaff; and sheep enjoy pease straw as much. These products of the pulse crops are considered much too valuable to be given as litter. Since bean-chaff is so much relished by cattle, there is little doubt that bean and pea haulm, cut into chaff, would not only be relished, but be economically administered; and were this practice attended to in spring, the hay usually given to horses at that season might be dispensed with on farms which grow beans and peas. It is said that when work-horses are long kept on bean-straw their wind becomes affected.

(1962.) Of all the different sorts of straw, it appears that wheat, oats, pease, and bean-straw are used for fodder, and that barley-straw is fit only for litter; and that where there is a sufficiency of oat and bean straw, wheat straw might also be dispensed with as fodder. This being the relative positions of the different kinds of straw, their supply should be so arranged as to prevent the waste of fodder-straw in litter, and this may be easily accomplished by having oat-straw in the straw-barn with barley or wheat-straw. The procedure should be in this wise:—In the early part of winter, the grain chiefly in demand is barley. Barley straw should therefore be supplied, stack after stack, until all the stock, with the exception of the seed-corn, is disposed of. During winter, the corn for the horses should be thrashed, and laid up in granary, and, as common oats are usually given to horses, the best sort of fodder could thus be supplied simultaneously with the litter-straw of barley. After the barley is disposed of, towards spring, the demand for wheat commences, and then the wheat-straw should come in lieu of that of the barley for litter. Farther on in spring, the bean straw comes in in lieu of oat-straw for fodder. In this way the time may pass on until grass is ready for stock. See (13.).

(1963.) The colour of the fodder-straw affects the colour of the dung of the various animals; thus, pease and bean straw and chaff make the dung quite black, wheat-straw gives a bleached appearance to the dung of horses, and oat-straw gives it a yellow hue.

(1964.) I don't know that the specific gravity of straw has ever been ascertained by experiment; but I should say, judging only by surmise, that oat-straw is the lightest, and wheat-straw heaviest.

(1965.) It may be interesting to you to give the constituents of the different sorts of straw spoken of. These consist of organic and inorganic substances. The organic substances resolve themselves ultimately into the four elements of oxygen, hydrogen, carbon, and nitrogen. The inorganic matters consist of a considerable number, a tabular view of which is here given under each sort of straw, for the purpose of comparison. According to the analyses of Sprengel,

1000 lb. of	wheat straw	leaves	35.18 lb.	of ash.
...	barley	...	52.42	...
...	oat	...	57.40	...
...	rye	...	27.93	...
...	bean	...	31.21	...
...	pea	...	49.71	...

And 100 lb. of the *ash* of each of these sorts of straw gave the following constituents:—

Constituents.	Wheat Straw.	Barley Straw.	Oat Straw.	Rye Straw.	Bean Straw.	Pease Straw.
	lb.	lb.	lb.	lb.	lb.	lb.
Potash,	0½	3½	15	1	53½	4¾
Soda,	0¾	1	a trace.	0½	1½	—
Lime,	7	10½	2¾	6	20	54¾
Magnesia,	1	1½	0½	0½	6½	6¾
Alumina,	2¾	3	a trace.	1	0¼	1¼
Oxide of iron,	—	0½	a trace.	—	0¼	0½
Oxide of manganese,						0¼
Silica,	81	73½	80	82¼	7	20
Sulphuric acid,	1	2	1½	6	1	6¾
Phosphoric acid,	5	3	0¼	2	7¼	4¾
Chlorine,	1	1½	a trace.	0¾	2¾	0¼
	100	100	100	100	100	100

On comparing the numbers in these columns, we cannot fail to remark how much potash there is in the straw of the bean; how small a trace of soda there is in all the straws; how large a proportion of lime there is in the straw of the pea, compared to that of the bean; how large it is compared to that in the grain of the pea itself; how much more silica in the straw of the pea than in that of the bean; but how much more phosphoric acid in bean-straw than in that of the pea.

(1966.) "The inorganic matter contained in different vegetable productions varies from 1 to 12 per cent. of their whole weight. The following table exhibits the weight of ash left by 100 lb. of the dry straw of the more commonly cultivated plants, according to the analysis of Sprengel:—

Dry straw of wheat, 3.51 lb. per cent.
... barley, 5.24 ...
... oats, 5.74 ...
... rye, 2.79 ...
... beans, 3.12 ...
... peas, 4.97 ..."

(1967.) Such are the kinds, uses, and constitution of the straw usually found on farms; and the proper management of them, so as to confer the greatest comfort to stock, and procure the largest amount of manure to the farm, is a matter deserving of much consideration. I fear there is too much truth in the observation of Sir John Sinclair, when he says on this subject, that "the subject of straw is of greater importance than is commonly imagined; and the nature of that article, taken in the aggregate, entitles it to more attention than has hitherto been bestowed upon it. Farmers are apt to consider it as of little or

* Compiled from Johnston's Lectures on Agricultural Chemistry, pp. 260 and 318-21.

no worth, because it is not usually saleable, and is rarely estimated separately from the yearly produce of the soil. But though seldom saleable, except in the vicinity of towns, it has an intrinsic value as a fund for manure, and a means of feeding stock."*

(1968.) The proper management of straw which I allude to, is, that the respective kinds shall always be appropriated to their best uses, that is, the straw best adapted for litter shall not be administered as fodder, for if it be, the animals will thereby be rendered discontented; if barley-straw, for instance, is put before cattle that have been, or should have been, accustomed to oat-straw, they will not only not eat the usual quantity of fodder, but eat that which they are obliged to eat with disrelish. On the other hand, if fodder-straw is strewn abroad for litter, it is not used to the best advantage, being partly wasted. Again, if more straw is thrashed at a time than can be consumed in a few days in fodder, what of it remains to the last becomes dry and brittle, and unfit for the use of stock; and even litter-straw, if kept for a long time before it is used, becomes much lighter, and, of course, loses a portion of its value. So far, therefore, as the straw is concerned, it is bad practice to stack up thrashed straw for a long time, as some farmers seem fond of doing, for it then certainly wastes some of its properties as fodder or litter. The plan is, to thrash the straw when and as often as it is required, both for fodder and litter, and it will be always in the freshest state for use in both ways. But to follow out this plan successfully, requires the previous consideration whether there are a sufficient number of stacks in the stackyard for the purposes of fodder and litter throughout the season, and if there is, then those should be selected which are best suited, of the respective kinds, for those purposes, during the winter, when the utility of good straw is most appreciated. The remainder can be used for the inferior purposes of bottoming the courts and stacks of the ensuing crop and season. Should the whole quantity of straw, however, seem inadequate to the demands upon it, then it should be thrashed only as required, and dealt out with an economical and judicious hand, so that no part of the season shall be worse or better supplied than the rest. Do these considerations usually engage the attention of farmers? I fear not, but certainly not so much as they deserve. I am aware that it may here be observed, that it is of much greater import for the interest of the farmer to study the state of the market for grain, than to lose that advantage by not thrashing out the straw. This is feasible, but, at the same time, is the farmer aware how much injury he may receive by loss of condition in stock, and deterioration in dung, by being inattentive to the state of his straw? I suspect the subject has received but little of his consideration.

(1969.) It was at one time a prevalent notion, that straw could not be converted into good manure unless it were consumed by cattle and horses; and the celebrated Bakewell carried this idea to such a height, that if he had not stock sufficient of his own to consume his straw, he took in those of others for the purpose. But he lived to see his error. Opinion changed to the opposite extreme, so that many farmers persuaded themselves into the belief that straw *consumed* by stock was wasted, and that it should only be used as litter. This latter opinion is nearer the truth than the former, but goes beyond the truth; for although it is quite correct to say that stock ought to *depend* on green crops

* Sinclair's Code of Agriculture, p. 361.

for food to fatten them, yet it is also true that that food is much assisted in its assimilation into the animal system, by a participation of fodder. It is not merely that the stomach requires to be distended by food, but sweet dry fodder is an agreeable change to the ox after a hearty meal of turnips. Feeding stock really consume very little fodder; and when it is placed before them at pleasure, they may either partake of it, or pick out a few choice straws, or let it alone altogether; thus affording creatures as much liberty of choice in their food as their confined situation will admit.

(1970.) The *value* of straw may be estimated from the quantity usually yielded by the acre, and the price which it usually realizes. Arthur Young estimated the straw yielded by the different crops—but rejecting the weaker soils—at 1 ton 7 cwt. per English acre. Mr Middleton estimated the different crops in these proportions:—

	Cwt.	lb.	
Wheat-straw, ...	31 or	3472	per acre.
Barley	20	2440	...
Oats	25	2800	...
Beans	25	2800	...
Pease	25	2800	...
Average rather more than	25 or	2862	...

or 1 ton 5 cwt. per English acre. Mr Brown, Markle, East Lothian, computed the produce of straw as follows in stones of 22 lb. per Scotch acre, which I have contrasted with the imperial:—

	Stones.	lb.	cwt.	lb.	
Wheat-straw, . . .	160 or	3520 or	31	48	per Scotch acre.
Barley	100	2200	19	72	...
Oats	130	2860	25	60	...
Beans and pease, . . .	130	2860	25	60	...
Average,	130 or	2860 or	25	60	per acre.

or 1 ton 5 cwt. 60 lb. per Scotch acre, or 1 ton 0 cwt. 76 lb. per imperial acre.* In the immediate vicinity of Edinburgh, the produce, both in Scotch and imperial measures, per acre, is this:—

			Stones.	lb.	cwt.	qr.	lb.
Wheat-straw, 9 kemples of 16 st. of 22 lb.		=	144 or	3168 or	28	1	4
Barley ... 7		=	112	2464	22	0	0
Oat ... 8		=	128	2816	25	0	16
Average, 8		=	128 or	2816 or	25	0	16

or 1 ton 5 cwt. 16 lb. per Scotch, or 1 ton 0 cwt. 13 lb. per imperial acre. On comparing this result,—from the vicinity of a large town, where a large supply of manure can always be obtained—with Mr Brown's general estimate for the whole country, and finding the quantity less, we must conclude that Mr Brown's estimate is above the mark as an average one for the country; and unless the production of straw be very much greater in England than in Scotland, we must also

* Sinclair's Code of Agriculture, p. 362-3.

conclude that the estimates of both Arthur Young and Mr Middleton are above the general average ; 1 ton the imperial acre of weight for straw is too high an average for Scotland.

(1971.) In regard to the market value of straw, it being usually prohibited to be sold except in the vicinity of towns where manure can be received in return, it is only from the value received for it in towns that we can form an estimate of its value. In Edinburgh, the usual price for wheat-straw is 12s. per kemple of 16 stones of 22 lb., or 9d. per stone ; and for oat-straw, 10s. the kemple, or $7\frac{1}{2}$d. per stone. This statement brings out and contrasts the values in Scotch and imperial measures :—

Wheat-straw, 144 st. of 22 lb. at 9d. per st. = L.5 : 6 : 4, per Scotch acre of 10 bolls of 4 bushels, = 10s. 7d. per boll.
Oat ... 128 ... ... $7\frac{1}{2}$d. ... = 4 : 0 : 0, ... 10 bolls of 6 bushels, = 8s. per boll.

Equivalent to

Wheat-straw, 181 st. of 14 lb. at $5\frac{3}{4}$d. per st. = L.4 : 6 : 9, per imp. acre of 8 bolls of 4 bushels, = 10s. 9d. per boll.
Oat ... 161 ... ... $4\frac{3}{4}$d. ... = 3 : 4 : 0, ... 8 bolls of 6 bushels, = 8s. per boll.

In those parts of the country where straw, with its corn, is allowed to be sold on foot—that is, as it grows in the field—but prohibited from being sold by itself, the price for wheat-straw is 6s. per boll of 4 bushels, and 5s. per boll of oat-straw of 6 bushels. The quantity of straw per boll and per bushel will stand thus :—

Wheat-straw,	14 st.	8 lb.	of 22 lb.	per boll of	4 bushels	=	3 st.	11 lb.	per bushel.
Oat	...	12	...	17	...	...	...	6	...	=	2	...	3	...	...
Or Wheat	...	18	...	1	...	14	...	...	4	...	=	4	...	7	...	...
Oat	...	16	...	1	...	...	...	6	...	=	2	...	9	...	...

(1972.) The Romans used straw as litter, as well as fodder, for cattle and sheep. They considered millet-straw as the best for cattle, then barley-straw, then wheat straw. This arrangement is rather against our ideas of the qualities of barley and wheat-straw ; but very probably the hot climate of Italy may improve the quality of the barley-straw by making it drier and more crisp, and render that of the wheat too hard and dry. The haulm of pulse was considered best for sheep. They sometimes bruised straw on stones before using it as litter, which is analogous to having it cut with the chaff-cutter, as recommended above. See (1889.).

(1973.) Where straw is scarce, they recommend the gathering of fern, leaves, &c., which is a practice that may be beneficially followed in this country, where opportunity occurs. Varro says, " it is the opinion of some that straw is called *stramentum*, because it is strewed before the cattle." *

* Dickson's Husbandry of the Ancients, vol. ii. p. 407.

40. OF THE WAGES OF FARM-SERVANTS.

"The husbandman that laboureth must be first partaker of the fruits."
ST PAUL.

(1974.) Winter is the time in which *wages in kind* are paid to farm-servants; and the part of that season chosen for the purpose is about the end of the year. It is requisite that harvest shall be completely over in the latest season, and every preparatory operation connected with the accommodation of stock, either on turnips or in the steading, be gone through, before the business of thrashing the crop in a regular order be commenced. In connection with thrashing the crop, a plan should be adopted for supplying straw for fodder and litter, as recommended in (1692.), as well as for placing a quantity of new oats in the granary, to be drying, and to be ready for use by the time the perhaps small stock of old corn shall be consumed. After all these preparatory operations incidental to winter have been accomplished, and before much of the new crop has been disposed of at market, further than to ascertain its general quality and price, the first leisure afforded by them is taken for paying the farm-servants their yearly wages of corn; and as the quantity distributed is considerable on a large farm, and as all the servants should receive their wages at the same time, to avoid jealousy, there will be a considerable quantity of thrashed grain in the barn before the distribution takes place. The servants receiving a variety of corn, that kind should be first distributed which is found most convenient for the farmer to thrash; and each kind should be delivered, and the barn cleaned out, before another is interfered with.

(1975.) I have already enumerated the different classes of labourers employed on a farm from (244.) to (256.); and I may here mention generally, that the wages of all may be classed under three heads; 1*st*, Those consisting chiefly of *kind*, that is, of the produce of the farm, and but a *small* sum in *cash*; 2*d*, Those consisting of a *large* proportion of *cash* and *small* amount of *kind*; and, 3*d*, Those which consist *entirely* of *cash*. The recipients of the first and third classes may be engaged on the same farm, and the third class may be found exclusively on a farm, but the first and second classes are never found together; and as all three modes of paying wages co-exist in this kingdom, though in different parts of it, they afford a criterion for judging which is the best mode for all parties, for master and servant; which the most convenient for the master, which the most conducive to the servants' comfort and

moral habits. *Ploughmen* or *hinds* constituting the principal or staple class of labourers on a farm, like the battalion-men in a regiment, the terms of their wages are taken as a standard of comparison for those of the rest.

(1976.) *Ploughmen's wages.*—These are paid in all the three modes enumerated above (1975.), the first mode being in general adoption in the Border counties of England and Scotland; the second mode being practised in the midland and northern counties of Scotland; and the third having long been adopted in the southern counties of England.

(1977.) Wages in *kind and money* differ, in their constituent items, in different counties, but only in a slight degree; the aggregate items affording sufficiency of food to support a ploughman and his family. I shall enumerate the particulars received by the ploughmen of Berwickshire and Northumberland:—

In Berwickshire.

10 bolls = 60 bushels oats, at 12s. 10½d. per boll,	L.6	8	9
3 ... = 18 ... barley, at 19s. 10½d.	2	19	7½
1 ... = 6 ... peas, at 23s. 3d.	1	3	3
12 ... = 1200 yards potatoes, at 4s.	2	8	0
A cow's keep for the year, ...	8	0	0
Cottage and garden, ...	1	10	0
Carriage of coals, ...	2	0	0
Cash, ...	4	0	0
Equal to 10s. 11¼d. per week,	L.28	9	7½

In Northumberland.

6 bolls = 36 bushels oats, at 12s. 10½d. per boll,	L.3	17	3
4 ... = 24 ... barley, at 19s. 10½d.	3	19	6
2 ... = 12 ... peas, at 23s. 3d.	2	6	6
3 ... wheat, at 47s. 2d. per quarter,	0	17	8½
3 ... rye, at 29s. 4d.	0	11	0
40 ... potatoes, at 1s. . . .	2	0	0
24 lb. of wool, at 1s.	1	4	0
A cow's keep for the year, ...	9	0	0
Carriage of coals, ...	2	0	0
Cash, ...	4	0	0
Equal to 11s. 5d. per week,	L.29	15	11½

To the money value of both particulars I attach no importance, farther than giving to them a tangible form; for the *prices* of agricultural produce affect neither master nor servant in their relation to one another, the point simply being, that the master supports the servant in an ade-

quate manner. Any difference, therefore, shewn in the weekly wages between 10s. 11¼d. and 11s. 5d., as brought out in estimating the money-value of the particulars, does not in fact exist, because the ploughmen of both counties live equally well. Instead of taking an imaginary rate of prices, I have selected the aggregate average, as given in the Universal Corn Reporter of 20th January 1843. Besides working a pair of horses, the ploughman is bound to supply a field-worker, whether a woman or a boy, usually the former, whenever the farmer requires her services, and who receives for her work 10d. a-day, and in harvest 2s. 6d. a-day, besides victuals. In harvest-wages there is a difference between the two counties, and it is explained in this way. In Northumberland, it will be observed, that the rent of the house and garden is set down at L.3 a-year, whilst the ploughman receives 2s. 6d. a-day, and victuals, for the field-worker in harvest; whereas, in Berwickshire, the ploughman is bound to work the harvest as rent for his house and garden, receiving only victuals, which I have estimated at that season at 1s. a-day for 30 days, which is as long a period as harvest may be expected to last, and which should be deducted from L.3 of rent. There is also a difference in the cow's keep. In Berwickshire, the allowance is 60 stones of 22 lb. of hay in winter in lieu of turnips; but turnips are always preferred, and these are given to the amount of 6 double horse-loads, 3 of white and 3 of Swedes. In Northumberland, 10 cart-loads of white turnips are given, or 5 of white and 3 of Swedes; or, in lieu, 1 ton of hay, or 100 stones of 22 lb.; so that the Northumberland cow is better off by L.1 in winter than the Berwickshire, and the difference is certainly so far an improvement on the condition of the English hind. Both cows have as much straw as they can use. The grain which the ploughman can claim is next in quality to the seed-corn; and in Berwickshire he receives it in advance at the end of the year, which is in the middle of the year's engagement from Whitsunday (May) to Whitsunday. In Northumberland, the corn is paid in advance once a quarter. The corn is ground, in any way the ploughman pleases, at one of the small mills of the country, for the mere miller's multure; so he saves the profits of the retail-dealer. If he cannot consume all his corn, the farmer willingly takes what he has to spare at the current market price. The produce of the cow, over and above what is required to serve the ploughman and his family, may be disposed of; and if the cow is a good one, and the season favourable, and the wife a good dairymaid, a considerable sum may be realized from the cow during the year. Her calf, if early and gotten by a well-bred bull, will fetch L.2, and perhaps more; if late, it may still be worth 20s. The refuse of the dairy, of the garden, and the

house, enables the ploughman to fatten two pigs every year; one for his own use, and the other to dispose of. The cow is the ploughman's own property; and to lose her by death is a serious affliction upon him. I have seen men with families much injured by such a loss, and could never refrain from rendering the poor fellows some assistance. To avert so serious a calamity to a poor man, *cow-clubs* have been established, to purchase cows for the members who may have the misfortune to lose them. Farmers subscribe according to their number of ploughmen, and each ploughman who wishes to enjoy the benefit subscribes 1s. a quarter to the funds of the club.

(1978.) Wages, *more in cash than in kind*, are more extensively given in Scotland than the plan which I have just described. Those who receive this species of wages are chiefly single men, living either in the farmer's house, or in a house by themselves called a *bothy*. The practice of allowing farm-servants to take their meals in the farmer's house is falling fast into desuetude, and its abandonment is much to be regretted, for it is a far better plan for the comfort of the men themselves than the bothy system. But married men are also supported in this form of wages, though their condition is not so good as that of the ploughmen on the preceding plan, but it is certainly preferable to the bothy system.

(1979.) The portion of wages received in *kind* consists of oatmeal and milk. The meal amounts to 2 pecks per week for each man, that is, 1 stone of 17½ lb., which makes 6½ bolls per annum, or 65½ stones of 14 lb.; and this at 1s. per peck gives a money value of L.5, 4s. a-year. The milk is supplied either fresh from the cow or after the cream has been skimmed off, according to agreement. In the former state it is given to the amount of 1 Scotch pint or 2 quarts a-day; and in the latter state, 3 quarts are given in summer, and 2 in winter. The value of the milk is usually estimated at L.4 a-year. In some cases a cow or cows are supplied to the men, who milk them, and are exchanged for others when they go dry; but supplying milk is the least troublesome plan for the master. These items of *kind*, with from L.10 to L.14 a-year of cash, varying with the rate of wages in the country, or according to the skill of the ploughman, constitute the earnings of a ploughman on this system. It is only in the amount of cash that these wages vary at any time, for what is given in kind is considered invariable, being no more food than a stout man can consume; but some cannot consume it all, and save a part of the meal, which they either dispose of to the farmer or to dealers. In strict fairness, the meal should be given to the men every week, but to save trouble, it is dealt out once a month or once a fortnight. The milk, of course, is supplied every day.

(1980.) Besides these principal ingredients, the married men get a house and garden rent-free, and coals are driven free to their house. The single men are provided with a room containing a number of beds, which are occupied each by two men; and the bed-clothes, consisting of a chaff-ticking and bolster, blankets, sheets, and coverlid, are provided by the master, and replaced clean every month. This room is called the *bothy*, and it usually forms both the sleeping-chamber and cooking-apartment of all its inmates, which may amount to as many men as there are ploughmen employed on the farm. The men are supplied with fuel all the year round, with which to cook their victuals, and which they do for themselves. The fuel consists of wood, brushwood, or coal, according to the supplies of the locality; but in winter, coal is always laid in to the extent of 1 ton each man. Salt is also provided by the master; and he also furnishes a pot for cooking in, a dish for holding milk, and some forms, and perhaps a table; but this last article of furniture is often dismissed from the bothy with little ceremony, a form, or the lap, making a much more desirable dinner-board. A few potatoes are generally given in winter.

(1981.) The oatmeal is usually cooked in one way, as *brose*, as it is called, which is a different sort of potage to porridge. A pot of water is put on the fire to boil, a task which the men take in turns; a handful or two of oatmeal is taken out of the small chest with which each man provides himself, and put into a wooden bowl, which also is the ploughman's property; and on a hollow being made in the meal, and sprinkled with salt, the boiling water is poured over the meal, and the mixture receiving a little stirring with a horn spoon, and the allowance of milk poured over it, the brose is ready to be eaten; and as every man makes his own brose, and knows his own appetite, he makes just as much brose as he can consume. The bowl is scraped clean with the spoon, and the spoon licked clean with the tongue, and the dish is then placed in the meal-chest for a similar purpose on the succeeding occasion. The fare is simple, and is as simply made; but it must be wholesome, and capable of supplying the loss of substance occasioned by hard labour; for I believe that no class of men can endure more bodily fatigue, for ten hours every day, than those ploughmen of Scotland who subsist on this brose thrice a-day.

(1982.) The ploughmen who receive *cash for wages*, are in the same condition as day-labourers, who receive their earnings once a-week, and purchase their subsistence at retail dealers in country towns and villages. This, I believe, is the condition of most of the ploughmen in the southern counties of England. There is one obvious remark, occa-

sioned by this statement, which cannot fail to be considered by every farmer, which is, that unless money-wages adapt themselves to the fluctuating prices of the commodities upon which farm-servants subsist, servants so paid must suffer much privation on a rise in the price of provisions; and, on the other hand, when prices again fall, they receive higher wages than they are entitled to. They are thus subjected to vicissitudes in their condition, from which the two former classes of ploughmen are exempt.

(1983.) The *wages of stewards* are in all respects similar to those of the ploughmen of whom they have the charge, the only difference being in the amount of cash received, which is always greater than that given to the ploughmen. Instead of L.4, given to the former class of ploughmen, they may receive L.12 or L.15, and instead of L.12 or L.14, given in cash to the latter class, they may receive from L.20 to L.25; and if there is any difference in the size or situation of the servants' houses, the best is appropriated to them. In most cases the steward is exempt from attendance on the farm on Sundays, whilst in others he takes his turn along with the other men, which latter is the better plan for the master, as the steward can then have much better opportunity of observing whether the men fulfil their duties properly.

(1984.) The *shepherd* receives the same amount of kind and money as the ploughman; but as he is accounted a skilful servant, and his hours of attendance extend every day from sunrise to sunset, he has leave to keep a small flock of sheep of his own, which is maintained by his master, and the produce of which he is entitled to dispose of every year. His flock consists of breeding ewes, which vary in number from half a score, such as of Leicester ewes in the low country, to perhaps two score of Black-faced ewes in the highest districts. About $\frac{1}{5}$ of the number of the ewes being disposed of every year, he is entitled to retain as many ewe-lambs of his flock as will maintain the full number of his breeding ewes. The shepherd's dog is his own property, often purchased at a high rate, and trained with much trouble and solicitude.

(1985.) The *hedger*, being considered a day-labourer or spadesman, gets a smaller proportion of kind than the first class of ploughmen, and more money, and generally no cow's keep; and where the second class of ploughmen exist, no hedger is kept as a hired servant, but is viewed in the light of a day-labourer, and is paid money-wages accordingly. Being a skilful man, the hedger never receives less than L.40 a-year in value, and more frequently L.1 a-week. He can sow corn, build stacks, and do any thing that the steward can, and sometimes all that the shepherd can besides.

(1986.) The *cattle-man*, being viewed as a labourer, receives some of his wages in kind and the rest in cash, and is seldom indulged with a cow. Being generally a person somewhat advanced in life, the rate of his wages is not high—perhaps 9s. a-week; and it is well when such a post as this can be given on a farm to an old and faithful ploughman or shepherd, whose growing infirmities disable him from undertaking his former active duties.

(1987.) The *field-worker* is simply a day-labourer, and receives 10d. a-day, without any wages in kind, from the farmer. This person is usually a woman. The first class of ploughmen are each bound to supply a field-worker for the farm during the year, they receiving the wages earned by the workers in that time. They hire the women in the public markets, and support them in their houses with bed and board and wages. Should the field-worker obtain constant employment on the farm, the ploughman may profit by the arrangement. On large farms field-workers are almost constantly employed. The practice had, no doubt, arisen at a time when few women could be persuaded to work in the fields; and the circumstance of ploughmen being bound by agreement to supply such labourers, these latter have long been designated by the odious name of *bondagers*, an epithet no doubt left us in legacy by our feudal forefathers. The practice has been found fault with, and even represented as a species of slavery, probably because of the odious designation given to the condition of the women; but the truth is, there is no more binding or slavery about the matter than in the case of the ploughmen themselves, and even less, for they are bound by agreement to work for a year, whereas the *bondager's* term is only for six months. The epithet is a nick-name, and should be relinquished for the proper name of field-worker; but the practice is good, because it enables the farmer to command a certain number of hands at all times, and also to accomplish his ends by his own resources, independent of extraneous aid. It is no answer to say that women may be hired out of villages when their services are required, because many large farms are situate far from any village; and even the vicinity of a village will not secure a supply of field-workers, as I have myself experienced to my vexation; for whenever trade is brisk, manufacturers not only pick up all the hands they can procure, but the work which they supply being done by the piece, at which greater wages than at field-work can be earned in long hours of labour, a temptation is presented to women labourers to desert the fields; and to such a degree of stringency is this monopoly of labour carried by manufacturers that they will not allow their people to go and assist at harvest. A resource of labour like the Border system

should, therefore, not be yielded by the farmer, until a better, or one as efficient, can be substituted. Its hardship, however, is not imputed to the workers themselves but to the ploughmen who must hire them; but if there is any hardship in it to the ploughmen, they nevertheless engage in it voluntarily with all its inconveniences, rather than abandon their profession; though, no doubt, if a man have no family, and the work is but limited, the support of a field-worker may press hard upon his gains, but there is this alleviating circumstance, even in such a case, that the burden is imposed upon a man who has no family to support; whereas, a family of daughters is a great source of income to a ploughman, one doing the bondage-work, others being paid for their labour, and all contributing to the support of a common fund. The system has no bad effect on the bondagers themselves; for they are cheerful and happy at work, and are well clad on Sundays. Nor are they ever put to any labour beyond their strength; for as to the alleged "*unfeminine* practice of females driving dung carts,"* the practice is not more unfeminine than helping to fill dung carts, or turning dunghills; but the fact is, women do not *drive* carts in the usual sense of that term, they only walk beside the cart, in the absence of *the driver* at more laborious work, to and from the dunghill to the place of its destination, merely to keep the carts clear of one another, and when so employed they have nothing to do with the yoking or loosening of the horse, or filling or emptying of the cart, or turning in or out of the landings. In the northern counties of Scotland no such obligation exists on the ploughmen, nor indeed can be, for it would be impossible to coexist with the bothy system, where a ploughman has not a house for himself, far less for any worker; and hence in those parts of the country field-labour, in as far as the *manual* operations are concerned, is very much inferior to that executed on the Borders, because of its being performed by casual labourers instead of those who have been steadily trained up to it from early youth; and as long as *no means* are used to initiate young people, especially young women, who are admitted to be more nimble in the fingers than men, in the several varieties of field labour, so long will they be imperfectly executed.

(1988.) Now, on taking a retrospect of the actual condition of all the labourers of the farm, as I have endeavoured to represent it, and comparing the condition of the first class of ploughmen with the others, the question that naturally occurs to the mind is—Which is the best? I have not the slightest hesitation in expressing my conviction of the superior position of the ploughmen in the Borders. Let us look into one of their cottages of an evening. I grant that their cottages might be made much more comfortable and much more convenient,

* Report of the Cottage Improvement Society of North Northumberland for 1842, p. 51.

and much better suited to the wants of their inhabitants, than they are; and this I shall endeavour to shew in due time; but in the mean time I may say that a determination exists for improvement in this matter evinced by parties most able to do it, namely, the landlords, and its good effects will be seen in the course of a few years; but look into one of their cottages, such as they are, during a winter evening, and "you will probably see," to use the words of Mr Grey, Dilston, on this subject, in the letter and spirit of whose sentiments I cordially concur, "assembled the family group round a cheerful coal-fire—which, by the way, is an inestimable blessing to all classes, but chiefly to the poor of this country—females knitting or spinning—the father, perhaps, mending his shoes —an art almost all acquire—and one of the young ones reading for the amusement of the whole circle." Contrast this with the condition of those ploughmen in England who receive their wages entirely in cash, and who have to go to a distance to purchase the necessaries of life. "Contrast this," continues Mr Grey, "with the condition of many young men employed as farm-servants in the southern counties, who, being paid board-wages, club together to have their comfortless meal in a neighbouring cottage, with no house to call their home, left to sleep in an out-house or hay-loft, subject to the contamination of idle companions, with no parent's eye to watch their actions, and no parent's voice to warn them of their errors; and say, which situation is best calculated to promote domestic comfort, family affection, and moral rectitude?" Contrast this also with the bothy-system, which perhaps Mr Grey has never witnessed, or no doubt it would have met with his reprobation: contrast this with a system which, although it supplies the necessaries of life in a convenient enough form, presents them in uncomfortable circumstances, affording no assistance to cook the food and clean out the chamber; affording no one to admonish thoughtless young men, many of whom are in the practice of wandering at night after a long day's toil, and returning home only in the morning, to begin a day's work, with wearied limbs and depressed spirits. In the winter evenings, too, the bothy is a scene of lewd mirth, excited by the company of females who have come perhaps from a distance to visit their acquaintances, and who are treated most probably with a stolen fowl, entertained with profane jests and songs, and afterwards convoyed homewards amidst darkness and wet.

(1989.) "One very obvious benefit," observes Mr Grey justly, in regard to married ploughmen, "arising to the hind from this mode of paying in *kind*, besides that having a store of wholesome food always at command, which has not been taxed with the profits of intermediate agents, is the absence of all temptation which the receipt of weekly wages and the necessity of resorting to a village or town to buy provisions, hold out of spending some part of the money in the ale-house, which ought to provide for the wants of the family; and to this circumstance, and to the domestic employment which their gardens afford in their leisure hours, we are probably much indebted for the remarkable sobriety and exemplary moral conduct of the peasantry of the north." And farther, "this mode of engaging and paying farm-servants is not only more conducive to their welfare and social comfort than the weekly payment of money-wages—which go but a little way in purchasing the necessaries of a family, are injudiciously laid out, and sometimes wastefully squandered,—but it has, besides, a strong and apparent influence upon their habits and moral character; it possesses the advantage of giving to the peasant the use of a garden and cow, with the certainty of employment; it gives him a personal interest in the produce of his master's

farm, and a desire to secure it in good condition; it produces a set of local attachments, which often lead to a connection between master and servant, of long continuance." *

(1990.) Beneficially as this system of paying farm-servants in kind has long operated both for master and servant, it has been stigmatized by persons even in Parliament, as being only another form of the *truck-system*, which has been made to act so prejudicially against the interests of operatives in England. But what *is* the truck-system? After hearing the proper answer to this question, we shall be the better able to judge whether the ploughman's wages paid in kind can truly receive that appellation. Of the truck-system, Mr Macculloch says that it is "a name given to a practice that has prevailed, particularly in the mining and manufacturing districts, of paying the wages of workmen in goods instead of money. The plan has been for the master to establish warehouses or shops; and the workmen in their employment have either got their wages accounted for to them by supplies of goods from such *depots*, without receiving any money; or they have got the money, with a tacit or express understanding that they were to resort to the warehouses or shops of their masters for such articles as they were furnished with." † If this be any thing like a correct account of the properly reprobated truck-system, it is clear that it has no affinity to the system in *kind*, in which the hinds are paid their wages, inasmuch as this has no reference to the *money value* of any article which the hinds receive, and therefore they *always receive the same amount of kind*, and of course the same rate of wages; whereas the truck-system has undoubted reference to the *money value* of the articles dealt out to, or purchased by, the operatives; and that money value is fixed by the master, whose interest it is, of course, to keep it at as high a rate as practicable, or else to give out articles of inferior quality at the price of those of more value; and hence the artizan does not always receive the same amount of goods, nor the same rate of wages.

---

41. OF CORN-MARKETS.

"Thus all is here in motion, all is life;
The creaking wain brings copious store of corn."

DYER.

(1991.) The surplus grain of the farm is disposed of to corn-merchants, millers, bakers, distillers, and brewers. These attend on the market-day in the market-town. If the market-town is a sea-port, most of the corn-merchants and brewers reside in it permanently, and have their granaries there. When the market-town is situate in the interior of

* Journal of the Royal Agricultural Society of England, vol. ii. p. 186-8.

† Macculloch's Commercial Dictionary, art. *Truck-System*.

the country, the merchants and brewers attend the market there from the nearest sea-port. The purchase of grain is chiefly carried on in winter, when the farmer has his crop to dispose of. Brewers and distillers chiefly buy barley for malting, millers and bakers chiefly wheat and oats, and merchants every species of grain. The market for barley commences the season, wheat and oats being then disposed of according to the demand for them; but after March the demand for both increases, to supply the consumption until next harvest. In a corn district, from which most of the produce is carried away to large towns or manufacturing districts, it is most convenient for the shipment of grain that corn-merchants reside in sea-port towns.

(1992.) Corn-markets are of two kinds, *stock* or *sample* markets. A *sample market* is that in which farmers bring hand samples of the grain they wish to dispose of, exhibit them to purchasers, and deliver the stock or bulk at an appointed time.

(1993.) A *stock-market* is where farmers bring in the grain they have to sell in bulk upon their carts, exhibit a bagful of it, sell the quantity brought, deliver it to the purchasers immediately after the sale is effected, and then receive the money for it. A merchant who *sells* grain in a stock-market does so by sample, and never thinks of bringing *his* stock, which perhaps consists of granaries-full, to the market-place; and there is nothing to prevent farmers also to sell their grain by sample in a stock-market.

(1994.) When sold by sample, the grain is *delivered* by the farmer in his own carts in the course of the few days allowed him for the purpose, either at the granaries of the merchant, brewer, or distiller, or at the mill of the miller. Water-proof tarpaulins are required to cover the sacks in the carts when grain is delivered in a rainy day, but it is better to defer the delivery until fair weather, if not otherwise inconvenient.

(1995.) When sold in bulk, corn is delivered immediately after the sale at the granaries of the merchants on the spot, or at the brewery, or distillery, or mill in the country, according to agreement.

(1996.) The *payment* for grain sold by sample is only made on the market-day after the delivery has been effected; but the payment of that sold in bulk is due, and is generally received, on the day it is sold, soon after its delivery at the granaries.

(1997.) Of the two modes of selling grain, each has its advantages and disadvantages to the farmer. It is *very convenient* to take a quantity of grain to market, sell it, deliver it on the spot, and receive the cash for it immediately afterwards. It enables the farmer to transact his market business at once, and saves him the trouble of attending

next market-day on purpose to receive the cash, when he may have no other occasion to be there. It obliges, in a great degree, merchants to provide granaries for the reception of grain in the interior market-towns; as farmers may refuse to deal with a purchaser who wishes the grain delivered at a distance from the market-town, the fatigue to their horses being thereby probably much increased. This mode of selling grain has also the advantage of securing the farmer against bad debts, because he may deliver the grain and receive the value for it simultaneously. On the other hand, it is attended with this great disadvantage, that in case the farmer does not sell his grain on the day he has brought it to the market-place, he is either obliged to take it home again, or put it into a granary until the next market-day, when, of course, granary-rent must be incurred, and the additional expense also incurred of either hiring carts to deliver the grain next market-day, from the temporary granary to that of his purchaser, or of sending a cart of his own to do it; and as he must keep the grain so accommodated in sacks, he may be deprived of the use of his sacks at a time when he may have a large quantity of corn in his barn to measure up, and which, where lying in a loose state, may be an inconvenience. Or to avoid these manifold and obvious inconveniences he must take the price offered for his grain. Another disadvantage is, that his horses must stand in the market-place, exposed for hours to cold blasts, after perhaps being heated on their way to the market-town. The exhibition of corn in bulk gives power, however, to the purchaser to inspect the cleaning of every sack before purchasing it, and it also gives him the command of a quantity of corn immediately after its purchase.

(1998.) The *advantages* of a hand sample-market to the *farmer* are, that he is independent of the rate of price of any market-day; for if it does not satisfy him, he can put his sample into his pocket again. His men and horses cannot lose a day's work, and are not exposed to the weather in waiting in the market-place. He need not, moreover, clean his grain before selling it, and should he be induced to sell more than what is thrashed, he has time to thrash more and clean the whole quantity at once, thereby making the stock of uniform quality, and cleaned agreeably to the particular taste of the purchaser. The *disadvantages to the farmer* are inability to receive cash for the grain he sells until the next market-day after its delivery, and the risk he thereby runs of incurring bad debts with the merchant, to whom the stock is delivered some days before he pays for it. The *advantage* of a sample-market to the *merchant* is, that should the sample please him, he can purchase as large a quantity of grain as the farmer pleases to dispose of, and thus

make up a cargo of uniform quality; and the *disadvantage* which he experiences, which, by the way, is felt most strongly by the brewer, distiller, and miller, is, that he cannot obtain possession of the grain immediately after purchase.

(1999.) Of the two species of corn-markets, I prefer selling by the sample, chiefly because I dislike to see horses standing for hours with a load in the market-place, and most probably in bad weather, for none else can be looked for in winter. Such a stand cannot be for their advantage, and, in my estimation, the peculiar advantages of a stock-market is insufficient to counterbalance the risk thus incurred in the safety of the horses. This inconvenience is perhaps appreciated by some farmers, and a modification of the plan is followed, such as delivery in the course of a few days of a larger quantity of grain than what was actually presented in the market-place; but no modification can take place of the sale of grain by sample, in that it is simply the presentation of the hand sample in the market, the sale of the bulk therewith, and its consequent delivery at the specified time. It would be curious to observe the particular diseases to which horses are most liable, that are made to stand in a market-place for hours together, and to ascertain if these are of the class most commonly contracted from exposure to weather.

(2000.) Were all men honest, it would be immaterial which mode were adopted for the sale of grain, in so far as the *state* of the grain is concerned; but to the shame of the farmer be it spoken, it sometimes happens that the stock is delivered of an inferior quality, or not so well cleaned as the sample that was shewn in the market. Some farmers acquire a character for this species of fraud, and so blinded do they become by their cupidity, that they cannot discover the advantage which they thereby confer on the merchant to reduce the price of the bargain made between them. It is curious that men cannot at once believe that ill-cleaned corn cannot be so heavy, bulk for bulk, as well-cleaned. While such people, therefore, think they are taking advantage of the merchant by giving him light corn amongst the good, they are in fact cheating themselves, for no purchaser will pay the stipulated price of good corn when ill-cleaned corn is delivered to him instead. Many farmers, I apprehend, deliver stock inferior to sample, from no intention of committing fraud, but because they cannot deliver the stock so clean as the sample they have shewn, it having been differently treated from the stock. They are in the habit of pulling out a sample from the stack, rubbing out the grain from the ears, blowing away the chaff with the mouth, and picking out the light corn. Now no winnowing machine can clean

corn in this style. Or a sample is taken from the unwinnowed bin on the barn-floor, and treated in a similar manner. Sample and stock can only agree exactly when both are derived from a similar state of the same parcel of grain.

(2001.) On the other hand, I must say, in justice to the farmer, that some corn-merchants are very fastidious on receiving stocks of grain that have been sold to them by sample. The stock is objected to at the granary, because it is inferior to the sample; and when this plea cannot be substantiated on comparison, the bulk is declared deficient in measure, which objection cannot be rebutted without measuring over the whole quantity, and on this being done, and this objection also proving groundless, it is rejected, because the grain is lighter than that guaranteed by the farmer. But the object is to *set up* the grain any how, to give the merchant an opportunity to reduce its price. To shew how such a circumstance as this can happen, I may observe that the merchant seldom witnesses the delivery of grain at his granaries, this duty being deputed to the man who has charge of the granaries, and its delivery cannot of course be witnessed by the farmer. So if the merchant's foreman receive the clue to make objections, these are easily made to appear effective to the farm-servants delivering the grain, who of course know nothing of the conditions of the bargain. The corn is then *set up*, that is, set down in the sacks on the floor, and remains there unemptied until an explanation takes place; on which, if the farmer has committed an error, he suffers a considerable reduction in price, but if he can maintain his own rectitude, the merchant concedes the point, and throws the blame on his stupid foreman, who, after all, is justified for the interruption he had given, by the allegation that he had only done his duty to his master. I have heard of both these species of frauds being attempted to be committed, and have also heard a remark connected with one of them, that merchants are most likely to be fastidious, in regard to the quality of the grain they receive, when prices happen to fall between the period of purchase and that of delivery. Unfortunately, no such motive can be urged to justify the farmer in his attempts to pass off inferior grain. In a stock-market, no such occurrences can happen. Let me say here, that my sole object in alluding to so painful a subject is to make you aware of the tricks of trade.

(2002.) Every species of grain is directed by the Weights and Measures Act (5th Geo. IV. c. 74, sec. 15), to be sold by the imperial *bushel*, fig. 307, (1743.) containing 2218.192 cubic inches, and not 2150.42 cubic inches, as erroneously given in that paragraph, this latter number being the contents of the old Winchester bushel, which is now obsolete,

and there is no such recognised quantity as a quarter, boll, coom, or load. The practice has settled into measuring grain into half-quarter sacks of 4 bushels, which forms a convenient size of load, fig. 306, in the barn, as well for carriage on men's backs (1741.), as in carts, Plate XVIII.

(2003.) Granaries in towns are frequently situate in inconvenient places for access to carts, such as in narrow streets and lanes; and some are so inconveniently high, that four or five flights of steps have to be surmounted ere the floor be attained which is to contain the corn; and these stairs are not unfrequently too narrow or too steep, or the steps so worn away in front as to endanger the safety of the persons who carry loads up them. But the risk is fully greater to those who have to bring loads down them, when the contents of the granary are emptying for the loading of a ship. For the carriage of corn in such a case, I have seen a convenient form of *bag* used. It consisted of a short sack capable of holding rather more than 2 bushels, drawn together at the bottom, where a short piece of thick pliable rope is attached; the mouth being formed like any other sack. The person who is to carry the bag folds the mouth together when filled, so as to cover the corn, and at the same time leaves a portion of the sack loose, by which he holds firmly with his right hand. On assistance being given him to lift the sack when filled, he turns himself quickly round with his back to it, and brings the part by which he holds on, over his head; and holding on there with one or both hands, as he chooses and feels most convenient in the circumstances, literally runs with the load to the ship's hold, where, on a man seizing the short rope at the bottom of the sack, the carrier hitches the sack off his back, and the grain is poured into the hold, while the man all the time retains hold of the short rope.

(2004.) For long in Scotland, grain used to be sold by *measure alone*, and for long it used to be sold in Ireland by *weight alone;* but both ways are liable to objection. When the measure alone is used, there is a temptation to measure the corn before it is properly cleaned, especially if the corn is sold; and when sold alone by weight, there is also a temptation to retain light corn amongst the good, with the view, in both cases, of disposing of the inferior grain at as good a price as the fine. But a check has of late years been established against both species of frauds, by a statement of the weight along with the bulk. Merchants know the weight of grain by its appearance and feel, and therefore, by trying the weight of a 4-bushel sack, they can easily ascertain whether the grain is in as clean a state throughout the whole bag as at its mouth. But the introduction of the weight has given rise to a species of deceitful dealing as regards the public. The purchaser offers

a certain price for every so many pounds weight of the grain, without direct reference to the contents of the bushel; and some farmers are induced to sell on this plan, in the vain hope of being able to boast that they have sold their grain at such a price, wishing it to be believed that the price applies to the true quarter, when in fact it is given for so many pounds weight, and to deliver the number of pounds for the specified sum the bushel is heaped. This is pitiful work. The fair and common practice is to ask such a price for the grain per quarter, stating its weight by the bushel; and, of course, the heavier the grain, and better the quality, the purchaser will give the higher price for it.

(2005.) The usual denominations of corn measures, based upon the imperial bushel, the standard of capacity, are these:—

4 Gills	= 1 pint,	contain	34⅔	cubic inches.	
2 pints	= 1 quart,	...	69⅓	...	...
4 quarts	= 1 gallon,	...	277⅓	...	...
2 gallons	= 1 peck,	...	554⅔	...	...
4 pecks	= 1 bushel,	...	2218⅔	...	...
8 bushels	= 1 quarter,	...	10¼	...	feet.
5 quarters	= 1 load,	...	51¼	...	...

(2006.) In regard to the sale of corn, these settled points in law may prove useful for you to know. "In sale by sample, the buyer may decline the bargain, if the bulk does not correspond with the sample (Parker, 4 Barn. and Ald. 387.) The delivery of the sample does not transfer the property of the bulk (Hill, Jan. 20, 1785, M. 4200.) The *price* must consist in current money, either of Great Britain or some foreign country, which has a determinate value put upon it by the tacit consent of the state: if in goods, it will be barter and not sale; and if illusory, it will be donation. The price must be certain, as well as the subject sold. It is generally fixed by the parties themselves at striking the bargain. Where a purchaser of oats, payable on delivery, temporized with the seller, and delayed to take delivery for a fortnight, during which period the price of oats rose, it was held that he was not entitled to demand delivery (Craig, May 29. 1823, 2 S. D. 347.). . . . In sales of grain, the price is sometimes fixed by the Sheriff's fiars. In the case of Leslie (Jan. 27. 1714, M. 1419 and 1678), where there was an agreement to purchase grain without a price specified, it was held, *inter alia*, that fiars' prices may be presumed the sale between landlord and tenant; and that merchants are presumed to contract according to the current prices of the country where the bargain is made. As to the risk of sale after the subject is sold, the loss is to the purchaser, as in the case of Campbell (July 15. 1748, M. 10,071.), and in the case of Tarling (1827, 6 Barn. and Cres. 361.). But it was held in the case of Milne (Feb. 1. 1809, F. C.), that where the seller takes upon himself the delivery of goods at a certain place, it throws the risk of the goods, while *in transitu* to that place, on the seller. . . . Where the seller has delayed delivering the subject to the purchaser when bought, he is liable for the risk; but it is not considered delay, when the purchaser declines paying the price. Also, when a landed proprietor sells a certain quantity of grain of a particular crop to a mer-

chant, without specifying any particular parcel, and the whole crop is destroyed, the loss is to the seller; but after such quantity of grain is measured, or otherwise prepared for delivery, the risk will be tranferred to him; so found in the case of Hinde (7 East. 558.); Erskine, iii. 3. 7." In regard to the landlord's hypothec over corn, restitution was given in the case of Scot (June 11. 1673, M. 6223.), of corns bought from a tenant while under hypothec. Though, when bought in public market, where they have been brought in bulk, the purchaser is not liable in restitution; if brought only in samples, the landlord is entitled to restitution. This was held in the case of Smart, Dec. 10. 1793, and Earl of Dalhousie, Feb. 27. 1828, 6 S. D., 626."* So that a stock-market is safer for a purchaser to buy in, and a sample market is safer for the hypothec of a landlord.

---

42. OF THE FARM-SMITH, JOINER, AND SADDLER.

"Yet, Sir, if you be out I can mend you."
JULIUS CÆSAR.

(2007.) The *iron*, the *wood*, and the *leather*, connected with the implements of the farm, being in constant use, are always in a state of gradual decay, and require almost daily repair. To effect repairs, it may be impracticable to send the articles to the nearest town, or even village. Where either is at a distance exceeding one mile from the farm, much time will be lost in sending every article to be repaired; so, in such a case, it is incumbent on the farmer to provide a smithy and joiner's shop at hand; and as to the saddler, his work only requiring to be done at long intervals, accommodation can be afforded him in the steading for the time he is employed. The remarks which I have already made in regard to the position which the smithy and joiner's shop should occupy being sufficient (79.), I need not repeat them here.

(2008.) The degree of wearing to which the *iron* of the implements is subjected, depends, in a great measure, on the nature of the soil of which the farm is composed. When the soil is sharp and gravelly, it wears down iron much faster than when it is clay or soft mould. The iron that wears most in work is that belonging to the movable parts of the plough, such as the coulter and share, and the shoes of horses. To protect those parts from wear as much as possible, it is usual to point and edge the coulter and share, and to tip the horses' shoes with steel, which, although incurring greater expense at first, is an economical material in clay and soft soils, inasmuch as plough-irons, used in those classes of soils, only require repair every few days; but in sharp and gravelly soils,

* The Farmer's Lawyer, pp. 136-8 and 47.

steel is a useless expense, for it is found to wear down almost as fast as iron, and it is therefore more economical to sharpen the plough-irons every day, than to lay them with steel. To some implements, such as harrows, the same remark applies; and as for the rest, which are seldom used, the difference of expense attending their repairs with iron or steel is immaterial.

(2009.) With regard to horses' shoes, it is their fore-bit which first wears down, and so long as horses confine their work to the farm, there is no harm in their shoes becoming thin, provided the crust of the hoof is protected from injury by the ground. In some parts of the country, the shoes of farm-horses are made in a preposterous fashion. They are made very thick and heavy, being provided with high caulkers and broad and thick fore-bits, elevating the horse a considerable distance above the ground, and endangering him by tramping on himself in turning at the landings, or in backing and turning in the cart. It is therefore both a useless and an injurious fashion. The Dutch carry this fashion to a ridiculous height. All that is required is a slight turning up or thickening of the heels, and particularly of the outer heels, and a little thickening of the fore-point of the shoe. The pretext for using high shoes, or pattens, as they should rather be called, is to afford the horse a resistance with the caulker in going down, and a grip with the fore-bit in going up hill with a load; but such a form of the shoes in those parts, as is mentioned above, is quite sufficient for those purposes; and besides, when a horse has the perfect liberty of action of his feet which light shoes afford, he will be much better able to guide himself in every circumstance than with clumsily-formed heavy shoes. This mode of reasoning in favour of heavy shoes may be allowed in the case of the carrier's horse, which is constantly on the road, though even he is encumbered with loaded shoes; but it is inapplicable to the farm-horse, which performs the greatest part of his work on soft earth, and but seldom encounters steeps upon the public roads; and, at all events, it is absurd to encumber him with heavy shoes on a farm for the greatest part of the year, merely because he may have to go up and down a steep part of a public road a few times in a season. But clumsy shoes are used on roads which have no steeps at all, so their use arises more from custom than from local necessity. This objection of mine to high shoes is not unreasonable, for I have seen horses' feet bearing numerous marks of being trampled on where such shoes were used. On disusing them myself, against the practice of the country where I farmed, I was assured, by the smith even, of lameness from straining soon overtaking the horses; but notwithstanding these forebodings, not a single case of tramping occurred afterwards, and certainly no case of lameness from strains. Tramps are

dangerous, besides causing blemishes on the foot, for when serious, they may cause quittor, which may terminate in ring-bone, and in consequent chronic lameness.

(2010.) There are two ways of having smith-work executed on a farm, one by the job, the other by contract. The mode by day's-work is expensive, the jobs being multitudinous in the course of a year, no efficient check can be placed against fraud. The most satisfactory way is to have the business done by contract throughout the year; and the simplest mode of contract is to take, as a standard of expense, the upholding of the most active portions of the iron-work of a farm, namely, the plough-irons and horses' shoes. Taking these as a criterion, it has been ascertained from experience, that L.3 a-year for every pair of horses is a fair estimate of smith-work on a farm. For this sum the smith binds himself to uphold plough-irons, horses' shoes, and *all the malleable iron* of every implement in use in working order throughout the year. It is not incumbent on him to *renew* any article, but only to mend it when broken, and repair it when worn. For a new article, when ordered to be made, its value is paid. In some parts of the country, smiths will not enter into contracts for upholding iron-work, as was the case in Forfarshire when I farmed there; and there is no want of charity in ascribing this unwillingness to a consciousness of being able to make more money by job-work.

(2011.) There are few farms so large as to afford full employment to a smith; and it is not the smith alone that must be constantly employed, but his apprentice also, whom it is necessary to engage, to enable him to get through the heavy parts of his work that require the use of the sledge-hammer, such as the forging of shoes. If the smith's forge is so conveniently situate as that the draughts of three or four farms can easily attend it, the smith then executes all the work in his own smithy; but when any farm is too far off, he comes to the smithy erected on the farm, as often every week as the work requires, and there finishes all the jobs for the time. In this latter case, it is not unusual for the farmer to supply the iron, and the smith to contract for the labour. Under any species of agreement, the farmer should insist on the smith having a large assortment of shoes ready forged, of sizes to suit the different feet of the horses, that no unnecessary delay be occasioned in the smithy when a pair of horses require a new set of shoes. This precaution is the more necessary, that smiths will not care how long they detain horses, provided they can get the assistance of the ploughman at the sledge-hammer, and thereby save the expense of hiring an apprentice.

(2012.) The wear of the *wooden* part of implements is not sensibly

affected by the nature of the soil. If a wooden plough is put to unusually rough work, such as trench-ploughing or tearing up old rough natural lea, its parts may become strained and even broken, and require renewal; but ploughs are now generally made of iron, and are placed wholly under the charge of the smith. Carts, however, suffer much when stones are driven for buildings and dykes, and tiles or stones for drains. In such a case, if old carts have not been purchased for the occasion, it is an economical plan for the contracting joiner to line the bodies of the carts with slabs of common fir or of willow, to protect the proper lining from injury. I purchased a couple of old carts for 50s. a-piece, and also 2 pairs of old seasoned horses to work in them, when there was much building and draining to execute on the farm, and the whole withstood the rough work for 3 years.

(2013.) The contract with the joiner is also usually L.3 a-year per draught, for which sum he binds himself to mend every article broken in the work, such as wheels, bodies, and shafts of carts, handles of the minor implements, and all wood-work connected with other implements. For a new article, such as a new cart, wheels, or harrow, he is paid its price.

(2014.) The accounts of the smith and joiner should be settled half-yearly, at the terms of Whitsunday and Martinmas. I may take this opportunity of impressing upon you the great injustice done to a tradesman, by disappointing him in the settlement of his accounts when they become due. He has made his arrangements with those who supply him with his materials on the understanding of receiving cash at each term, and if he cannot keep his promise, his credit suffers and his profits are diminished. The best excuse that can be made for inattention to this matter is thoughtlessness; but no man has a right to hurt the feelings or injure the credit of another upon much higher motives than forgetfulness. It ought to be known, that tradesmen in general will suffer much privation before they will complain of those who employ them, in the fear of losing their employment. This is no doubt wrong, for every man, be his position what it may, should endeavour to support an independence of character, but at the same time he is not altogether to blame, because his error is occasioned by the injustice of another, and were he left to act on his own responsibility he might evince a higher bearing; but on this very account his employer incurs a great moral responsibility in acting towards him whom he employs so as to cause a debasement of his character. Credit is the primary source of the mischief. It may be a good thing in commercial affairs, but the business of agriculture is best conducted in ready money.

(2015.) In regard to the *saddler*, he usually comes twice a-year and repairs the harness, at the end of the work in autumn, and immediately after the throng time in spring. He is either paid day's wages and provides himself with leather and every other material, or these are supplied him; or he undertakes to support the harness in working order by contract. I have been accustomed to see saddlery repairs paid in day's wages; but the general contract-price is 30s. a-year per draught. The portions of the harness that require most repair are the collars and saddles, where these are in constant contact with the horse's skin, and the paddings of which should be restuffed every half-year, and the cloth renewed, if threadbare or in the least rotten. The clippings of sheep, accumulated during the season, when washed and properly dried, coming from the coarsest parts of the wool, make good and cheap stuffing for collars and saddles. Care should be taken to make every loose bit of the sewing of leather tight, to prevent rain in winter or drought in summer penetrating into the interior of the harness, and thereby rotting or hardening it. The best leather ought always to be used, as being the most thrifty in the end, which consists of well tanned ox-hide. Untanned sheep-skin is employed to sew on the capes of the collars. Saddlers are not bound to uphold the iron-work of harness, such as plough-chains.

(2016.) I may take this opportunity of saying, that a stormy day, when the horses cannot go to work, should be taken advantage of to *clean the harness*. Work in summer and autumn not only dirties, but renders the leather of harness very dry, and if allowed to be in that state, it will crack. The harness should first be washed *clean* with a sponge and warm water, and hung up for that day to dry. The next day it should be rubbed over with sweet oil, especially on the outside; for the side which is constantly next the horse's skin may not require oiling at all, though it will require washing to remove incrusted perspiration and hair. If blacking is to be used at all, it should not be put on until the day after the oil has been absorbed by the leather; but for my part, I see no use of blacking at all, save only to make the harness *look* better. The blacking should be of the best shoe-blacking, which is not dear, being only 1s. per quart bottle, and which, if judiciously put on in small quantity and brushed firmly with a hard brush, will go over a large assortment of harness. The lamp-black commonly made use of for the purpose is a filthy thing, coming off and staining every thing in the first shower; and the common train oil, which is usually employed to soften the leather, is still more filthy, and is not unfrequently daubed on with a wisp of straw upon encrusted dirt.

(2017.) I may remark, in conclusion, that in all the three species of repairing work just mentioned, when contracted for, it is the *interest of the contractor* to make repairs as efficient as possible, and not to allow the wear of implements to proceed so far as to cause repairs nearly as extensive as a renewal; while, on the other hand, when repairs are paid in day's wages, it is as much the tradesman's *interest* that the same implement shall require frequent repairs. So well understood is this manœuvre in places where jobs are paid by day's wages, that I have heard of ploughmen being bribed by the smith to bring their plough-irons and even their horses in turns, to the smithy every night, whether repairs were required or not; and also of being bribed by the joiner to break the shafts and handles of the minor implements whenever they were much in use. Such roguery, it is hoped, is rare; but no species of roguery is *too mean* for human nature to practise. I speak not of such cases from personal experience; but cases of such frauds have been brought under my notice, as having been practised upon landed proprietors of my acquaintance who have home-farms, so well authenticated, that I cannot doubt their existence; and when things that have happened may happen again, it is my duty to apprise you of what you may expect to meet with when you engage in business on your own account.

43. OF THE FORMING OF DUNGHILLS, AND OF LIQUID MANURE TANKS.

> "If frost, returning, interrupt the plough,
> Then is the time, along the hardened ridge,
> To drive manure——"
>
> GRAHAM.

(2018.) Towards the close of winter, the dung will have accumulated so high in the large courts I and K, figs. 3 and 4, Plates III and IV, as to become nearly level with the feeding-troughs *z*, and thereby making them inconveniently low for the cattle; but before this inconvenience occurs, the dung should be removed and formed into dunghills in the fields intended to be manured in the ensuing season. The court K, besides its own litter and the refuse from the corn-barn C, contains the litter of the work-horse stable O, and the pig-sty *b*; and the court I contains the litter of the servants'-cow byre Y, besides its own. The dung from the cows' court *l* should also be taken away, to save annoyance to

cows heavy in calf wading in deep litter; and that from the courts of both the hammels M and N, if not from under the sheds, should also be taken away, for the same reason as given above in the case of the courts, that the feeding-troughs become too low, especially in the hammels M of the fattening cattle.

(2019.) I am thus particular in detailing the contents of each court, because, differing in their constituent parts, they should be appropriated to the raising of the crop best adapted for each sort of manure. For example, the court K contains a large proportion of stable litter, and not a little from that of the pig sties; so its contents are somewhat of a different nature from those of the court I, which contains nothing but the litter of cattle. If it is desired to raise a large extent of that crop which thrives best with a considerable proportion of horse-dung, the contents of the court K should of course be preferred to that of the other court I; and if any crop is best raised with cattle-dung, the contents of the court I and the cows' court *l* should be used for it. Or should the manure required consist of an average proportion for the raising of general crops, then the contents of all the courts should be mixed together. This method of appropriating the dung of a farm is not so much practised by farmers as it deserves; and it is not urged by me as a mere theoretical suggestion, but as practically being the best mode of appropriating manure to raise each crop to the best advantage. To make my meaning more intelligible, I shall illustrate it in this way. Suppose that carrots were desired to be raised on a field of light land, then the land should be dunged in the autumn with the contents of the court K, because it contains a large proportion of horse litter. When potatoes are attempted to be raised on heavy soil, which is not their natural one, they are most likely to succeed with horse litter also. Turnips, on the other hand, grow best with cow-dung, and therefore a mixture of the courts I and *l* would be best for them. Should carrots not be raised, and the soil be naturally favourable to the potato, and therefore horse-dung will not be specially wanted, the best way is to mix all the sorts of dung together, and form dunghills of average properties.

(2020.) There is another matter which deserves consideration before the courts are begun to be cleared of their contents; which is the position the dunghill or dunghills should occupy in the field, and this point is determined partly by the form which the surface of the field presents, and partly from the point of access to the field. In considering this point, which is of more importance than it may seem to possess, it should be held as a general rule, that the dunghill should be placed where the horses will have the advantage of going down-hill with the loads from

it. *Wherever practicable, this rule should never be violated, as facilities afforded to labour in a busy season are of the utmost importance.* If a field, then, has a uniformly sloping surface, the dunghill should be placed at the upper or highest side, but then the access to the field may only be at the lowest side. And it may be impracticable to reach the upper side by any road. In such a case, the loads should be taken up a ridge of the field; and when a field is so inconveniently placed, frosty weather should be chosen to form the dunghill in it, as the wheels and horse's feet will then have a firm bearing. But should it be found impracticable to lead dung to its upper side, by reason of the soft state of the land or steepness of the ascent, then the dunghill should be formed at the side nearest of access. If the field has a round-backed form, the dunghill should be placed on the top of the height; and in order to supply the ridges down both slopes from it with manure, a ridge, by way of head-ridge, should be formed along the crest of the height, at the time the stubble is ploughed. In a level, or nearly a level field, it is immaterial which side the dunghill occupies.

(2021.) The fields to which the dung should be carried are those to be fallowed in the ensuing season; that is, set apart for the growth of green crops, such as potatoes and turnips, and for the part which receives more cleaning than a green crop admits of, namely, a bare fallow. The potato culture coming first in order, the land destined for that crop should have its manure carried out and formed into the first dunghill. The turnips next come in hand; and then the bare fallow. The dunghills intended for potatoes and turnips should of course be made respectively of such a size as to manure the extent of land to be occupied by each crop. The manure for bare fallow not being required till much farther on in the season, may be deferred being carried out at present. The proportions and nature of the soils best suited for potato and turnip culture will be treated when we come to speak of those crops respectively, so that any remarks on these particulars would be irrelevant here.

(2022.) Then the precise spot which a dunghill should occupy in a field is not a matter of indifference. I have seen a dunghill placed in the centre of a field which it was intended wholly to manure. From this point, it is obvious, the carts must either traverse every ridge situate between the one that is in the act of being manured and the dunghill, or go direct to a head-ridge, and thence along it to the ridge to be manured. This latter alternative must be adopted if the dung is to be deposited in drills; for if not, the drills will be much cut up by the passage of the carts across them—a practice which should never be allowed

when neat work is desired. The dunghill should be placed on a head-ridge or a side-ridge of the field; and of these two positions, I would prefer the side-ridge, because, when the head-ridge is occupied in the length of a dunghill, the ends of all the ridges abutting against its side cannot be ploughed or drilled in their entire length; and if there are more than one dunghill on the same head-ridge, a considerable number of ridges may thus be curtailed of their fair proportions. The dunghill on a side-ridge affects only a part of the single ridge which it occupies. Should a field be large and require two dunghills, the one first to be used should be placed *along a ridge* at a distance just *beyond* the space of ground the manure it contains will cover, so that the ridge occupied by it may be ploughed to its end before it is manured; and the second dunghill should be placed along the farthest off side-ridge. The ridge occupied by the farthest dunghill, can be easily reached at a time when the earth is hard; but should the weather continue fresh and the ground soft, a dunghill should be made on the side-ridge nearest the gateway; and should no frost happen, this dunghill should be made large enough to manure the whole field. A large dunghill in one place will no doubt cause more labour to manure the field at the busy season, than would two dunghills at different places, but in soft weather and soil, it is better to incur the risk of future inconvenience, than allow the horses to drag only half-loads axle-deep along a soft head-ridge. When proper sites can be chosen for dunghills in fields, the loads, in the busy season, will not only be ensured a passage down hill, but the dung be situate at the shortest distance from the place it is wanted, and the ploughed and prepared land be uninjured by cart-wheels and horses' feet.

(2023.) Some consideration is even required in *littering the courts*, and especially the large courts L and K. No one would believe that any care is requisite in laying down straw in a court, but those who have witnessed the inconvenience and loss of time incurred in removing dung from courts, will easily perceive that this may be the case. The courts are usually cleared during frost, when time is erroneously regarded of little value, and when, as our motto implies, the plough is rendered useless; but notwithstanding of this common opinion, a loss of a small portion of time, even at this season, may have a material effect upon some future operations. For example: the hard state of the ground may favour the carriage of manure to a distant field, to gain which, most of the time is spent upon the road. Suppose frost continued as long as to allow time to carry as much manure as would serve the whole field, provided ordinary diligence were used, and no interruption met with in the courts. Suppose further, on manuring the field in summer, there was

found to be less manure in the dunghills, by a small quantity, than was wanted, and that a half-a-day or at most a whole day's driving from the steading would supply the requisite quantity, it is clear that the day's driving could have been accomplished in frost at much less trouble than at the season when the manure was wanted. But this sacrifice of time *must* be made at the instant, or the field be deprived of its just proportion of manure. This is no hypothetical case; it has occurred in every farmer's experience. Now, what is the primary cause of this dilemma? Either too much time had been spent upon the road in driving the manure, or much interruption had been experienced in the courts. To which of these two causes should the waste of time be ascribed? With regard to driving, farm-horses get into so regular a pace upon the road at all times, that little loss or gain of time can be calculated on in this particular; and besides, when a head of carts is employed at any work, every one must maintain its position in the routine, otherwise it will either be overtaken by the one behind, or be left far behind by the one before. The probability therefore is, that the loss of time is incurred in the courts, and for this reason. The usual mode of taking away wetted litter from the work-horse-stable is to roll it together with a graip, and then to throw it into a barrow, in which it is wheeled into the court, and there emptied on any spot to get quit of it in the shortest time, and left in heaps to be trampled down by the cattle. Backloads of thatchings of stacks, some of which are not very dry, are carried into these same courts, put down anywhere, and partially spread. Long straw-ropes, which bound down the thatching of stacks, are pulled along the top of the litter. In doing all this, and it is not all done at one time, no plan is followed with the view of *facilitating the lifting of the straw* afterwards, but as if it was to remain there always; but so far from this being the case, it is again lifted before it becomes short by fermentation, and there is considerable difficulty in doing so. Long damp straw is seized in one part by a graip, and the other parts, being coiled in the heap it was first laid down, cannot be separated without much exertion on the part of the ploughman, pulling it this way and that; and it is too soft to admit of its being cut with the dung-knife. Another graip encounters a long straw-rope, which, after much tugging, is broken or pulled out, and thrown upon the cart with its ends dangling over. In short, not a single graipful is easily raised, and the business is not expedited when a heap of chaff evades the action of the graip. Add to this the few hands generally sent to assist the ploughmen to fill the carts, and the consequent time spent by the team in the court, and some idea may be formed of the causes which incur much loss of time in this necessary work. It is

easy to conceive that, in this way, as much time might be lost in clearing all the courts as would give all the carts a half or whole day's driving, which is just what was required to remove the inconvenience felt when the field was manuring. The only method of preventing the recurrence of so great delay in carrying out manure, is to put down the litter so as it may be easily lifted, and to afford as much assistance in the court as to detain the horses but a short time, and rather keep them moving on the road; for though their walking was constant in a short winter day, it will not overcome them with fatigue.

(2024.) The *litter should be laid down in this manner* in the large courts I and K. On fixing on the gate of the court through which the loaded carts should pass to the nearest road to the fields requiring the manure in the ensuing season, and, after covering the ground of the court evenly with straw, the litter should be laid above it in small quantities at a time, beginning at the end of the court farthest from that gate. The litter should be spread with the slope of its lower part towards the gate, and carried gradually forward every day until it reaches the gate; and every kind of litter, whether from the work-horse stable, the stack-yard, or straw-barn, should be intermixed and treated in the same manner. The straw-ropes, as I mentioned before (1722.), should be cut into small pieces, and spread about. Thus layer above layer is laid, until they form a mass of manure of sufficient height to be carried out and formed into dunghills in the fields.

(2025.) When the time has arrived for *emptying the courts*, the process is *begun at the gate* through which the loaded carts are to pass, and, on lifting the litter, it will come up in sloping layers, having an inclination from the ground to the top of the dung-heap, not in entire layers of the whole depth of the dung-heap, but in successive small detached layers, one above the other, and succeeding one after the other, from the gate to the farther end of the court. The empty cart enters the court by the other gate, and, without turning, takes up the position of the loaded cart before it, which has just passed through the gate appointed for it. When there is only one gate to a court, and the court not very large, and a large lot of beasts in it, it is better for the empty cart to wait on the outside until the loaded one has gone away. When the court is large, with only one gate, the empty cart should go in and turn round to succeed the one that is being filled. On dropping work at mid-day, it will save time at starting again after dinner, to fill the first cart returning empty from the field that has not time to reach it again loaded and return before dinner time, and to allow it to stand loaded, but without horses, until the time for yoking, when the horses

are put into it, and the first load thus starts for the field immediately at the hour of yoking.

(2026.) On clearing a court, or any part of it, it should be *cleared to the ground;* because the manure made from a dung-heap that has been simultaneously formed, will be more uniform in its texture than that made from a heap composed of new dry straw on the top, and old wet straw at the bottom. Besides, it is much better for the future comfort of the cattle, that the court receive its fresh dry littering from the bottom, than if the wet bottoming were retained.

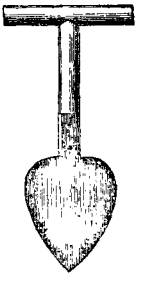
(2027.) Sometimes cattle get injured by a cart or horse when the court is emptying, and, to avoid this risk, it is not a bad plan to confine them under the shed as long as the people are at work in the court. The mode of confining them in the shed I have already alluded to in (18.)

(2028.) On *forming a dunghill in the field*, some art is requisite. One of a breadth of 15 feet, and of four or five times that length, and of proportionate height, will contain as much manure as should be taken from one spot in manuring a field quickly. Suppose that 15 feet is fixed upon for the width, the first carts should lay their loads down at the nearest end of the future dunghill, in a row across the whole width, and these loads should not be spread thin. Thus, load after load is laid down in succession upon the ground maintaining the fixed breadth, and passing over the loads previously laid down. After the *bottom* of the dunghill has thus been formed of the desired breadth and length, the further end is then made up with layer after layer, until a gradual slope is formed from its nearest to its farthest extremity. This is done with a view to effecting two purposes; one to afford an easy slope for the loaded carts to ascend, the other to give ease of draught for horses and carts to move along the dunghill in all parts, in order to compress it firmly. Every cart-load laid down above the bottom layer is spread around, in order to mix the different kinds of dung together, and to give a uniform texture to the manure. To effect this purpose the better, a field-worker should be employed to spread the loads on the dunghill, as they are laid down. When the further end has reached the height the dunghill is thought will contain of the desired quantity of manure, that height is brought forward towards the nearest end; but the centre of the dunghill will necessarily have the greatest elevation, because a slope at both *ends* is required to allow the carts to surmount the dunghill and then to come off it. It is an essential point to have the whole dunghill equally compressed, with the view of making the manure of similar quality throughout. After the carting is over, the scattered portions of dung around the dunghill should be thrown upon the top, and the top itself levelled along and across its surface.

(2029.) The *object aimed at by the compression* of the dunghill by the loaded carts, is to *prevent immediate fermentation.* So long as the temperature continues at its average degree in winter of 45°, there is little chance of much action in the interior of a dunghill; but towards spring, when the temperature increases, it may be expected to shew symptoms of action, but even then a temperature of 65° is required to begin the second stage of fermentation. Some advocate the covering of dunghills in the field with a thick layer of earth, with the view to exclude the air, and check fermentation; but such an expedient is unnecessary in the coldest months of winter, though it would be of service in spring to a dunghill which is not to be turned until the season is still further advanced. Others lay up the dunghill in a loose manner at once in graipfuls from each cart-load, giving the dung in fact a turning, and then cover it with earth, and trim round the sides with the spade. This form of dunghill looks neat, and, if the manure is to be used early, it is a good plan for obtaining it partially fermented for an early crop, such as beans; but for dung that is to be used at an advanced period of the season, when the temperature will have gradually increased to a considerable height during the day, the process is too promotive of rapid fermentation.

(2030.) The litter in the courts of the hammels, and especially in those of the hammels M, will be found much more compressed than that in the large courts I and K, in consequence of heavy cattle being obliged to move over it frequently within a limited space. It is sometimes so compressed as almost to resist the entrance of the graip. To enable it to be easily lifted, it should be cut in parallel portions with an implement called the *dung-spade*, fig. 364. This consists of a heart-shaped blade of steel thinned to a sharp edge along both sides; and its helve with a cross-head is fastened with nails in a split socket. The height of the spade is 3 feet, length of cross-head 18 inches, length of helve 18 inches, length of blade 16 inches, and breadth 10 inches. It is kept sharp with a scythe-stone. In using this spade, it is lifted up with both hands by the cross-head, and its point thrust with force into the dung heap, and it is then used like a common spade while rutting turf, with the foot upon the upper part of the blade. This part, it will be observed, is rounded and not left square with ears like a common spade, because when this spade is used to cut a dung heap of greater depth than the length of its blade, the round edge is not so apt to catch the litter as square ears, on the instrument being pulled

Fig. 364.



THE DUNG-SPADE.

up. A man's strength is required to use this spade effectively, a woman's arms being too weak for the purpose. Another form of instrument for cutting dung is like the common hay-knife, and is used in like same manner, and which will be figured afterwards; but it is not so efficient as this instrument, as will be shewn when we come to speak of the cutting of hay in spring.

(2031.) It is a practice of some farmers to keep the dung from the cow-byres in a loose state in the court. A space in the centre of a court is enclosed with a stout wall 3 or 4 feet in height, into which the dung is wheeled as it comes from the byre, and the dung-heap is accumulated to the height of the wall or even more, by means of a plank as a roadway for the barrow to ascend. The dung managed in this way never requires turning, and soon becomes in a state fit for use for potatoes or turnips. This plan saves the trouble of turning the dung, but this saving is not unattended with a disadvantage, for the dung must be led direct from the court to the field at a season when labour is precious, and when the field to be manured is far off, the extra time spent in leading out the manure to it may more than counterbalance any saving in the cost of turning. This dung might, it is true, always be reserved for the nearest field, but even the nearest may be at a considerable distance.

(2032.) Of late years the method of carting out a dunghill as described in (2028.) has been objected to, because it is alleged that many of the gases useful to vegetation are thereby dissipated. I do not see the strength of this objection in the winter season, when certainly no *decomposing* process can naturally originate or proceed. The water contained in the dunghill, it is true, may begin to evaporate at a very low temperature, even below 50°, but what harm can accrue from this? But as the fact is, that fermented dung must be prepared for some species of crops, of what avail would means to prevent fermentation be at a period not earlier than would be required to begin to ferment the manure so as it may be sufficiently so when applied? To obviate waste arising from fermentation, it has been theoretically suggested to make dunghills under sheds instead of in the open air; but how the mere screening afforded by a shed should *prevent* fermentation, though it may ward off rain, and keep the straw drier, and thereby *retard* fermentation, I cannot imagine. If the mode is proposed solely with the view to keep the litter dry, its fermentation will no doubt be retarded, but dry litter will never make *good* manure, as the usual state of litter under sheds can testify, which is in a state approaching to being *fire-fanged*, as it is termed, that is, in a smouldering heated state. Until a better mode of making dunghills in the fields shall *prove* the present one erroneous, we

must continue to follow it, encouraged by the success which has hitherto attended it.

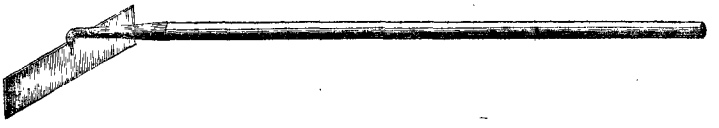
(2033.) An ingenious suggestion has been made by Mr Kirk, Preston Mains, East Lothian, to *check the spread of the seeds of weeds amongst manure.* His suggestion is founded on the general law of the growth of plants, that certain classes of soils affect certain classes of plants. This law I have endeavoured to illustrate very fully in paragraphs from (537.) to (556.), both inclusive. The suggestion is to put the manure of the straw obtained from one kind of soil on another kind of soil. Thus, the straw obtained from clay soil, that is wheat land, should be made into manure and applied to soil of light quality, that is turnip soil; and as, according to this law, natural plants, called by farmers weeds, which throve upon the clay soil would not do so upon the light, it appears to be within the power of the farmer to prevent, or at least to check, the propagation of weeds. Putting this suggestion into practice would be attended with some difficulty, for although Mr Kirk seems to think it easy "to make all the straw grown on one kind of soil into manure by itself," and which, he conceives, "might be accomplished with very little additional trouble to the farmer, where several hammels are employed in the feeding of cattle,"* yet in large courts it would be almost impracticable to prevent the mixture of straw of one stack off clay land with that of the succeeding one perhaps off light land; and even in the small courts of hammels it would not be easy to devise a plan by which a stack of straw off clay land should be used in them, while straw from light was in use for litter in other courts; and besides, the best fodder being obtained off light land, the cattle while using it could not be littered with straw off clay land, without running the risk of destroying the object in view. The suggestion, however, being founded on correct theory, might be subjected to *experiment*, which alone can ascertain its practicability.

(2034.) Immediately after a rainy day, when the land is in such a state of wetness as to prevent any work upon it, and the horses have nothing particular to do upon the road, two or three of the men should each take a *mud hoe* or *harle*, such as in fig. 365, and rake the loose straws and liquid mud on all the roads around the steading to the lowest side of the roads, and as much as possible out of the way of carts and people passing along; while the rest should take graips, fig. 257, and shovels, figs. 149 and 176, and form the raked matter into heaps, to be led away when it will bear lifting to the compost heap or field, as

* Quarterly Journal of Agriculture, vol. viii. p. 485.

may best suit the purpose at the time. Where there is plenty of straw, as on carse farms, some farmers put it upon the roads around the stead-

Fig. 365.



THE MUD HOE OR HARLE.

ing to be trampled down and become wetted with rain and then lead it away to the dunghill in the field. The object aimed at in so far as wetting the straw is attained, but such a littering makes walking upon the roads very damp and plashy. The best state for roads near steadings in winter is to have their surface *hard* and *smooth*, and with such an inclination as to cause the water run easily away into some ditch hard by. A scraping now and then with the mud hoe will make such a road dry and comfortable.

(2035.) I must now say a few words on tanks, liquid manure, and compost heaps. In fig. 4, Plate IV., may be seen the *liquid manure tank k'*, great in length and in breadth, inside narrow, and its depth under the soles of the liquid manure drains should not exceed 4 feet, for the reasons given below, its length being only extended to increase its capacity. The drains are marked by dotted lines from the tank towards *x*, in all directions, preserving them straight as practicable. Drains in straight lines, for a sluggish liquid, present fewer obstructions in their course than curved or angular ones. The form and dimensions of these drains may be seen in fig. 26, and (75. 2d.). At *x*, fig. 4, Plate IV., is an opening over the drains to allow the liquid manure to descend into them, and every such opening is protected by a grating such as is figured and described in fig. 25 and (75. 1st.). The liquid manure percolates through the grating, passes along the drains, and finds its way into the tank, out of which it is pumped with a cast-iron pump (76.) into a liquid manure cart, described below in fig. 366, in which it is carried to the field and distributed over its surface.

(2036.) *Tanks need not be built on every species of farm.* On *carse-farms*, where there is much straw and little green food, there can be no liquid manure; and on *pastoral-farms* the stock confined in winter in the steading are too limited in number to afford much of that material. On *dairy-farms*, on the other hand, where many cows are maintained and much green food consumed by them in byres, tanks might be con-

structed with advantage to the grass land. The practice of the farmers of Flanders might be usefully followed on such farms by having a small tank constructed under ground in connection with every byre, and the contents of which might be enriched with additions of rape-cake and other valuable ingredients. The enriched contents, employed as a top-dressing on pasture and forage land, appropriated to the support of the cows, might increase their produce very considerably. In collecting liquid manure on *farms of mixed husbandry*, if the steading is properly furnished with conveniences and the stock well supplied with litter, I do not see much can be done. I had a tank of 12 feet in diameter and 4 feet deep, connected with well planned courts by neatly-built drains provided with good gratings; and, at the same time, I had the courts defended from being deluged with rain water by capacious rain water spouts, and care taken that the cattle were always provided with a sufficient quantity of litter; having all these—which every well constructed and well conducted steading should never want—I can say that the tank was not filled in the course of the season above three times, a quantity not worth while providing a liquid manure cart to take it to the field; and even this small quantity was solely ascribable to heavy rains and melting snows, for a few days, falling directly into the courts, and causing a surplus of water which was readily conveyed into the tank by the drains. The usual supply of the liquid manure came merely in a few drops from the sole of the drain into which all the other drains immerged. The sole was only 4 feet above the bottom, and, except after rain or snow, the liquid manure never reached that height. I conceive that a small tank might be usefully constructed by a cottar possessing a small piece of ground, or large garden, and a cow, provided the cow were fed within doors in all seasons with green and soft food, as an excellent means of collecting manure that would otherwise be lost. Mr Milburn, Thorpefield, Thirsk, mentions "an instance of a small receptacle of this kind, where the owner has but one pig; he manages, however, by its aid in his garden to grow astonishing crops, and his garden produce is both earlier and superior to most of his neighbours." There is no question that much may be done in this way at farm-houses, hinds' houses, and villages, to collect matter, both solid and liquid, that would make valuable manure. A necessary might easily be constructed in connection with the liquid manure tank at a steading to receive the supply.

(2037.) Tanks *need not be expensively constructed.* Mr Milburn gives this statement as the expense of constructing a tank dug out of the ground 13½ feet in length, 6½ feet in width, and 6 feet deep, inside mea-

sure, with brick in length and mortar, and plastered with Roman cement:—

	Ft.	in.			
"Length within,	13	6			
Width,	6	6			
Depth,	6	0	= 19½ cubic yards.		
Cutting 31 cubic yards, at 3d per yard,				L.0	7 9
Walling, including bricks in length, and mortar around them, 31 cubic yards, at 4s. per yard,				6	8 0
Plastering and cement,				0	16 0
Covering and flags,				2	15 0
				L.10	6 9"

"A tank," continues Mr Milburn, "might be made under a shed, and composed of clay, and covered with slabs or boarding, or any refuse boarding. The expense of such a receptacle would be somewhere as under, dimensions the same as in the preceding case, viz.:—

"Cutting 31 cubic yards, at 3d. per yard,	L.0	7	9
Clay and carting,	0	14	0
Board and covering,	0	5	0
	L.1	6	9"

A tank of this nature, Mr Milburn suspects, would be subject to suffer in frosty and in very dry weather, as well as be liable to be perforated by worms. The frost and drought are serious objections to this particular construction of tank; but the worms might be prevented perforating the clay, were a little quicklime mixed with it;* but the true principles on which all tanks should be constructed are stated below.

(2038.) Winter is considered a favourable period for the *application of liquid manure*, both because it is then most abundant, and because the ground is in that loose and moistened state which readily receives and allows the liquid to incorporate with it. Any evaporation at that season is very limited, and is solely confined to the water contained in this liquid, and does not affect its more solid parts. Liquid manure may be applied either to grass or to bare soil, but is preferred for the former. It is distributed over its surface in the manner described under fig. 366, and the quantity required is from 800 to 1200 gallons the imperial acre. Its effects are sensibly felt both on old pasture, new grass, and on meadow; but where the quantity of the liquid is small, I would prefer applying it to the small paddocks, which are to be found on most farms, and which

* Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 280.

are usually in pasture and appropriated as an hospital, breeding ground, or a place of safety for young stock. The results of the application of liquid manure are best appreciated in summer, in which season we will revert to the subject.

(2039.) The space of ground adjoining the liquid-manure tank is a good site for the formation of *composts of various kinds*. Winter is not a favourable season for making composts, fermentation being then in a dormant state. I may state here, however, in general terms, that the carriage of *mould*, as the principal ingredient of a compost, is a laborious piece of work. Such a compost is best made on the spot where the soil is found; but when the foundation of a new building of any kind affords mould which would be removed at any rate, it should be used in compost, and will well repay the trouble of removal. Other materials than mould may, and indeed must, be carried, to form bases for composts; such as saw-dust, spent tanners' bark, boggy turfing that had been cast in summer and left to dry. These may be mixed with lime, or other fermentable substances, or beneficially watered with liquid manure. The haulm of potatoes, couch grass gathered from the fallow ground in summer, dried leaves, and other vegetable refuse, form valuable and substantial ingredients for composts, and when placed beside the tank, may be enriched with liquid manure.

(2040.) On laying down haulms of potatoes or quicken for compost, it is usual to throw down the loads without the least regard to order, because the excuse is, that when the potato-crop is taken up, every hand is too busily employed to do other things; and in summer, every hand is also put into requisition to gather weeds from fallow ground. In as far as the potato-crop is taken up and the weeds gathered in a proper manner, there can be no objection; but these are no reasons why the refuse created by these operations should be neglected and cause future labour and expense. The usual practice is to throw down the haulms and quickens in haste, and leave them in unequal masses to produce unequal decomposition. Instead of this, a field-labourer should be stationed at the compost-stance to throw them up with a graip into a heap of regular shape, when the materials will not only occupy the least space of ground, but be in the best state to receive any additions of liquid or solid matter, and when the most perishable portions of the materials are covered with the more durable, they are placed in the best state to preserve their properties. The neglect I complain of, of apparently unimportant materials, arises from this cause. There is too frequently a great tendency in farmers and stewards, when conducting labour in fields, to do what they consider the least important part of the work in a hasty

and unthinking manner, evidently forgetting that correction of hasty work always creates afterwards more labour than the part of the work for which it was neglected is probably worth. Many instances might be given of this sort of *two-handed work*, as it is termed, that is, work which has to be done over again; but I shall confine myself to the case before us. For example, were a field-worker or two placed at the spot where the haulms of potatoes are carried to form a future compost-heap, they could form it according to previous instructions from the cart-loads as they were thrown down; and in this way, when the carriage of the refuse was finished, so would also be the nucleus of the future compost-heap. But if the same materials are laid down at random in a scattered and confused manner by ploughmen anxious to get quit of their loads, considerably more labour will be required to place them in the same form of heap, and to to do it equally well, more hands and longer time will be required; because the materials have not only to be separated from a confused and compressed state, but to be collected together from a distance into the confined space upon which the heap is desired to be formed. Thus, 1 woman, favourably placed, will throw up with a light graip as much loose material, laid down before her in a small quantity at a time, as 3 or 4 women would place the same quantity and in the same position of materials thrown down and scattered as I have described them.

(2041.) Winter is the season which supplies the greatest quantity of *sea-weed for manure*. On farms adjoining the sea-coast, this manure is carefully collected whenever it is thrown upon the shore after a storm, or by a heavy ground-swell of the sea. Sea-weed is very succulent, and feels mucilaginous, and, when exposed to the summer's sun, is easily dried to $\frac{1}{3}$ its bulk, so little solid matter is contained in it. There are 4 species very common on our coast, and these are the *Laminaria saccharina*, consisting of a single linear elliptic leaf, without any mid-rib: the *Laminaria digitata*, or common tangle, a cylindrical stem, sometimes as thick as a walking-stick and about 2 feet long: the *Fucus vesiculosus*, consisting of a double stem, with the edges of the leaf entire, and in the disc of which, near the edges, are immersed a number of air-bladders—or crackers, as they are vulgarly called—about the size of a hazel-nut, and the use of which seems to be to cause the leaf to float in water: and the *Halidrys siliquosa*, consisting of a waved coriaceous stalk about 4 feet long, greatly branched, dark olive when fresh, but quite black when dry; is also furnished with air-bladders or crackers.

(2042.) The constitution of these plants is very complicated, affording no fewer than 21 ingredients. The first species, *Laminaria saccharina*,

afforded the following substances to the analysis of Gaultier de Claubry in 1815 :—

A saccharine matter—manna.
Mucilage, in considerable quantity.
Vegetable albumen.
Green colouring matter.
Oxalate of potash.
Malate of potash.
Sulphate of potash.
Sulphate of magnesia.
Muriate of potash.
Muriate of soda.
Muriate of magnesia.
Hyposulphite of soda.
Carbonate of potash.
Carbonate of soda.
Hydriodate of potash.
Silica.
Subphosphate of lime.
Subphosphate of magnesia.
Oxide of iron, probably united with phosphoric acid.
Oxalate of lime.

The composition of the other species, together with the *Fucus serratus*, —which is like the *F. vesciculosus*, but without air-bladders—and the *Chorda filum*, or thread tangle, is very similar to the one here given.*

(2043.) Sea-weed is applied in a *fresh state to grass land* that is intended to be ploughed up for a crop, and it is laid on as thick as to cover the ground. Being applied in winter, it does not soon become dry, and the rain and snow that may happen to fall upon it carries the saline ingredients, with which it is accompanied, into the ground, or amongst the roots of the grass. The large quantity of mucilage which sea-weed contains, and the numerous salts which it affords, may be the causes of its utility as a top-dressing and as an active manure. It has been recommended to dry sea-weed for the sake of being easily carried into the interior of the country; but this trouble seems unnecessary, because winter, when it is most abundant, is an unfavourable season to dry it, and because there is no more cast ashore than can easily be used by the farms adjoining the coast. On combustion in a certain way, sea-weed yields an impure alkaline substance called *kelp*, which is used as a manure. So long as this substance was used in the arts, it was too expensive for a manure; but its manufacture was stopped some years ago by the introduction of foreign barilla; and its value as a manure is not so well known as to induce the resumption of that manufacture. Many thousands of persons were employed at one time, on the shores of the main land and islands of Scotland, in the manufacture of kelp, who are now deprived of that employment. The same substance is manufactured on the coast of Normandy, and sold by the name of *varec*. Sea-weed, when burned in open air, leaves ashes, which afford most of the inorganic substances mentioned in the above analysis.

(2044.) [*The Liquid-manure Cart*, for the economical distribution of this

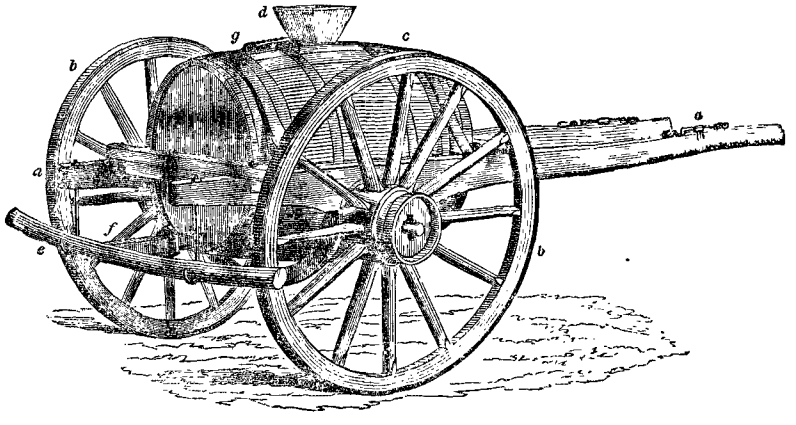
* Thomson's Organic Chemistry, *Vegetables*, pp. 944–6.

valuable manure, the natural production of the farm-stead, is now taking its due place amongst the machinery of the farm. The *water-cart* has been very long in use for the conveyance of water, when the supply of that necessary element for household use has been distant from the steading; and the liquid-manure cart is its offspring, modified by certain additions, to adapt it to this change of purpose. The water-cart is usually the naked bed-frame of a cart, mounted on wheels, and surmounted with a cask of a capacity suited to the demands of the establishment. The cask is furnished with a funnel, inserted in or attached immediately over the bunghole; and it is likewise furnished with a spigot, or with a stop-cock, inserted into that end of the cask which hangs over the back of the cart. When the water-cart has been drawn to the fountain or the pond, from which water is to be conveyed, it is filled either by means of a common pump, raised so high as to deliver the water which it lifts, into the funnel of the cask, or the water is lifted with the hand by means of a *scoop*, having a helve of sufficient length to enable the workman to reach the pond on the one hand and the funnel on the other. The scoop best adapted to this purpose is a small wooden pitcher, about 8 inches in depth and 10 inches in diameter, the helve passing through its sides in an oblique direction, and a little above its centre of gravity.

(2045.) The liquid manure cart, as most commonly used, differs very little from the above, except in its being provided with the distributing apparatus in place of the spigot; but in large establishments, the cask is superseded by a covered *rectangular cistern or tank*, which takes the place of a common cart-body. The *watering* of public streets and highways has induced the necessity of the rectangular tank for the distribution of water over the surface of roads, because of the ease with which, by this construction, a greater quantity of water can be put upon one pair of wheels. Here the quantity of water to a given surface is much greater than in the case of a liquid manure, and hence the propriety of a capacious tank for the distribution of *water* on streets, while the same principle (economy in the expense) leads to the propriety of employing a smaller and less expensive vessel for the distribution of liquid manure, which will not in general be superabundant. For a *liquid manure cart*, a cask of 120 or 140 gallons contents, will be found more economical in first cost than a rectangular tank; and as these machines can be only occasionally in operation, they will, if not very carefully attended to, become leaky while standing unoccupied. In this respect the cask will have a manifest advantage over the tank, for the tightening of a cask is an operation the most simple, by the act of driving up the hoops; while, in the case of the tank becoming leaky, no means of that kind can be resorted to, and the alternative is, either soaking it in water till the wood has imbibed as much of the fluid as will expand its substance and close the leaks, or the vessel must be tightened by some more expensive process. As the more economical of the two, therefore, in point of expense, I have chosen the cask-mounted cart for the illustration. Fig. 366 is a representation in perspective of this cart, of the simplest and most convenient construction. For the more easy means of filling the cask, it is suspended between the shafts of the cart, and this position requires the bending of the axle to nearly a semicircle. The cart is a mere skeleton, consisting of the shafts *a a*, which for this purpose may be made of red pine, their length being about 14 feet. They are connected by a fore and hind bar, placed at such distance as will just admit the length of the cask, while the width between the shafts is suited to the diameter of it. The

axle, as already noticed, is bent downward to nearly a semicircle, to receive the cask, and its length will of course be greater than the common cart-axle; even the distance between the caddy-bolts, in a straight line, will be usually greater, but this will depend on the diameter of the cask. A pair of common broad cart

Fig. 366.

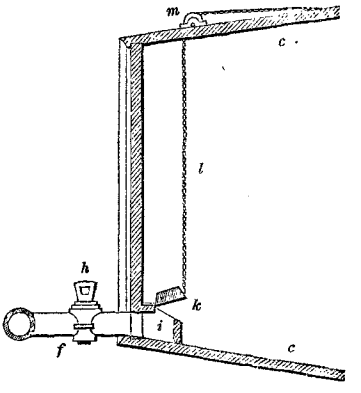


THE LIQUID MANURE CART.

wheels *b b* are fitted to the axle. The cask *e* is suspended on two straps of hoop-iron, 2 inches broad, the ends of which are bolted to the shafts, and the same bolts pass also through the ends of two lighter straps which pass *over*, and secure the cask firmly in its place. The funnel or hopper *d* is usually fixed upon the top of the cask over the bung-hole, or it may be inserted therein by means of an attached pipe. The distributor *e* may be made of sheet-copper, of cast-iron or malleable iron, or even of wood; the copper will be found the most durable, and it should be at least $\frac{1}{20}$ of an inch in thickness. The next best is the patent malleable iron tube; cast-iron, though sometimes used, is not to be recommended, neither is wood desirable, from its liability to choke. The bore of the distributor should be not less than 2 inches, nor is it required to exceed $2\frac{1}{2}$ inches, the length from 7 to $7\frac{1}{2}$ feet, and slightly bent with a uniform curvature, which last property causes it to cover a wider surface of ground than it would do if straight. But in giving the distributor its curvature, care must be taken to avoid increasing the curvature towards the ends, as is sometimes done, to the prevention of uniform distribution of the manure. The ends of the tube must be closed with movable covers, screwed or otherwise fixed, that they may be removed at pleasure, for the purpose of sponging out the tube when it happens to get clogged up with any solid matter. A line of perforations is made along the hinder side of the tube for the discharge of the fluid; these should be at the distance of 1 inch apart, and their opening about $\frac{1}{8}$ inch diameter. As the area of these discharging orifices cannot be altered at pleasure, nor their amount of discharge altered for any given time, it becomes necessary, in distributing any given quantity per acre, to regulate that quantity by increasing or diminishing the *rate* of travelling the cart over the ground. The distributor is attached to the cask by means of a stem *f* of the same materials and bore as the main tube, and it enters the end of the cask close to the lower

chime. A stop-cock is frequently put upon the stem *f* to regulate the discharge, and for this purpose it is very beneficial, serving in a great measure to regulate the quantity per acre, but for the entire setting off or on of the supply, the stem *f* opens into a small chamber inside the cask, which chamber is closed by a flap valve heavily loaded. This valve when closed stops the discharge, and when lifted the fluid has a free passage to the distributor. The opening of the valve is effected by a small chain attached to the flap, rising to the top of the cask at *g*, where it passes over a small roller, and onward to the fore part of the cart on the nigh side, where it hangs at hand for the carter to set off or on at pleasure. Fig. 367 is a section of part of the cask, and shewing the chamber and valve; *f* is again the stem of the distributor, *h* a stop-cock, *i* the chamber, and *k* the valve, which is the common leather flap or clack valve well loaded with lead, *c c* is part of the cask, *l* the chain attached to the valve and passing over the roller *m*.

Fig. 367.



THE APPARATUS FOR REGULATING THE DISCHARGE OF LIQUID MANURE.

(2046.) When the liquid manure cart is furnished with a *tank*, the latter can, with equal facility, be placed low for the convenience of filling; thus the axle may be cranked, as in the Liverpool dray-cart, the tank resting on the cranked part of the axle; or the axle may remain straight, and the tank appended below the axle. Such a tank may be conveniently built to contain a ton of the liquid, or about 220 gallons; and the distributing apparatus is the same as for the cask. The price of these carts vary considerably, partly from construction, and partly from locality. Mr Crosskil, of Beverley, quotes L.25 as the price of the tank cart. In Scotland the average price may be stated at L.18, and when mounted with a cask, L.15: these prices, of course, including wheels and axle.

(2047.) The *cistern* for collecting liquid manure in the farm-stead, though apparently simple in its construction, being merely a covered pond or a well, yet serious errors are frequently committed in its formation. The first and most important consideration for the formation of the cistern, is the effect of hydrostatic pressure; inattention to this has caused the failure of many such cisterns. The liquid we have here to deal with, like all other fluids, acts on the bottom and sides of the vessel or body that contains it, with a pressure directly in proportion to the depth at which the fluid stands, without reference to either length or breadth; that is to say, suppose a cistern whose bottom is 12 inches square, and its depth 10 feet, filled with water, every square inch in the bottom will suffer a pressure equal to the height of a column of water whose base is one inch square and 10 feet, or 120 inches, in height. The weight of such a column will be $4\frac{1}{2}$ lb. nearly, and this would be exerted on every square inch on the bottom, or the whole pressure on the bottom would be 625 lb., the weight of 10 cubic feet of water. There is a natural law that governs the pressure of fluids, which shews us that they press *equally in all directions*, downward, ho-

rizontally, and even upwards, the last arising from the general statical law, that "*action* and *reaction are equal and in opposite directions.*" It follows, from these hydrostatical laws, that the lowermost portion of *each side* of our supposed cistern will suffer a pressure from the water equal to that which acts upon the bottom, hence, taking the lowermost inch in the height of the sides of this cistern, it will be pressed with a force of 52½ lb. or thereby, or 4½ lb. on the square inch, and each of the four sides will suffer the same pressure. Suppose, now, that the cistern is elongated in one direction to any number of feet, and again filled to the depth of 10 feet, the pressure on each square foot of the bottom remains the same as before, and so in like manner does it remain the same upon the sides, for the pressure is not altered in any direction, although the proportion of the cistern has been changed. Keeping this in view, it will be seen that length and breadth produce no effect on the pressures that a fluid exerts against the vessel or body that retains it, and that, in calculating the resistance to sustain such pressures, *depth* is the only element requiring to be taken into account. It is also to be kept in view, that pressure on the bottom or sides is directly as the depth; thus, if our supposed cistern were reduced to 5 feet in depth, the pressure on the bottom would only be one-half, or 2¼ lb. on each square inch.

(2048.) The conclusion to be drawn from these remarks is, that a cistern in the form of a pit or well should be always avoided, unless it can be formed in a natural bed of impervious clay. When such a substratum can be attained, a pit may be adopted, but not otherwise. If such has been found, and the pit dug out, it should be lined with brick or with stone built in mortar, the bottom being first lined with the same material. When the building approaches to the surface, the wall can be gradually reduced in diameter to a small compass, leaving only an opening of 2 to 3 feet square, which is covered in at small expense, and the saving in this last item is the only apparent advantage that seems to attend the practice of pit cisterns. Deep cisterns are liable to another inconvenience, of their becoming recipients of spring or of drainage-water; and it is sometimes more difficult to keep such water *out* than to keep the proper liquid *in*, for if springs and their origin lay at considerable heights, their hydrostatic pressure may be so great as to render the prevention of access to their products a process of great difficulty.

(2049.) A *cistern* of moderate depth, not exceeding 4 feet below the out-fall of the drains, may be constructed in any situation, whether in gravel or in clay, and its length can be extended so as to afford any required capacity; the breadth being restricted to that for which materials for covering it, can be most easily obtained, which may be from 3 to 4 feet. Whatever be the stratum in which such a cistern is to be formed (unless it be perfectly impervious clay), it should be puddled to the thickness of at least 1 foot with the best clay that can be procured. For this purpose, the earthy matters are to be dug out to a depth of 1½ foot lower than the intended sole, and to a width of 4 feet more than that proposed for the cistern. Two or three thin layers of the prepared clay are then to be compactly laid over the whole breadth of the excavation, and beaten firmly together at all points, making up the depth to 1 foot, and the surface of it brought to a uniform level. Upon this the side-walls are to be founded, and these may be of brick 9 inches in thickness, or of flat bedded rubble stone 14 inches. The wall should be built in successive courses of about 1 foot in height, the whole being bedded in mortar, and, as each course is completed, the puddle is

to be carefully laid and beaten in behind, in layers of 6 inches or thereby, the first layer being properly incorporated with the foundation puddle, and each succeeding layer with the one immediately preceding it. To prevent the side-walls from being pushed inward by the pressure of the puddle or of the bank, tie-walls of brick or of stone should be formed at every 5 feet of the length of the cistern, these may be 9 inches of brick or 14 inches of stone; and they must have conduits formed at the level of the sole, to allow the liquid to run towards the pump. The sole should be laid all over with brick set on edge, or with strong pavement, the whole having a slight declivity towards one end, where a small well-hole of 9 inches in depth is to be formed to receive the bottom of the pump. The brick or pavement, as the case may be, is to be bedded on the puddle, and grouted flush in the joints with mortar; and when the walls and sole are built up, they should then be pointed in every joint with Roman cement. The covering is to be effected with strong pavement, of length sufficient to rest on the side-walls, laid and jointed with mortar; or with rough *found*-stones, where such can be procured, and if neither can conveniently be found, a beam of sound Memel fir may be laid along the middle of the cistern resting on the tie-walls, and, with this bearer, stones of half the length will be sufficient to form a cover. A thin layer of clay may be laid over the stone covers, and upon that a coat of gravel, by which means carts may be allowed to pass over it. To prevent accident, however, it is always desirable to construct the cistern in a situation where it will be as little as possible exposed to the transit of carts; and this may be always obtained at a small additional expense of covered drain to convey the manure from the dunghills to the cistern.

(2050.) The *pump* for lifting the liquid from the cistern to the cart may be either of wood or cast-iron, but the latter is preferable. A common sucking-pump of 3½ inches chamber is quite sufficient; the chamber should be bored out, and the pump-boxes, for durability, should be also of metal, with leathern flap-valves. The height of the pump should be such as to deliver the liquid freely into the funnel of the barrel, or tank; but if this height is found to raise the pump-lever above the reach of a man's hand, it is only necessary to joint a light connecting-rod to the lever, its lower end being furnished with a cross-handle, and by these means the pump-man will be able to work the pump in the same manner as the lower end of the common pit-saw. *Forcing* and *lifting* pumps have been proposed and even employed for the purpose we have here in view, though with questionable propriety; and here it may be proper to explain, that by the term *force-pump* is to be understood a pump that raises water to any height above the point where the power is applied, by the descent of a solid piston acting in the chamber of the pump, sending the liquid into an ascending pipe, which springs from *below* the piston. The *lifting* pump differs from this in having a valved piston through which the liquid passes, as in the sucking-pump, on the descent of the piston; and, on its ascent, the valve being now closed, the liquid is *lifted* and forced into the ascending pipe, which, in this case, springs from *above* the piston, the chamber being closed at top with a water-tight stuffing-box. From this brief description, the simplicity, both in construction and in management of the sucking or common pump, as compared with the other two, will be obvious; the cost being also in favour of the first.—J. S.]

45. OF WINTER IRRIGATION.

"Hence Irrigation's power at first was learnt,
A custom ancient, yet but rarely used
In cold and watery climes; though even there
No mode of melioration has been found
Of more effect, or with more ease obtained."

GRAHAM.

(2051.) It is not my purpose here to describe the mode of making irrigated meadows; that being a summer occupation, it will be attended to in due time. At present, I shall only describe the watering of meadows in winter. Suppose, then, that the meadows have been formed in a proper manner, and every channel cleaned with proper care, let us at once proceed to let on the water, and regulate its duration so as not only to preserve the vitality of the plants, but to promote their vegetation at an earlier period than the natural call of the season would arouse into action. As the late Mr George Stephens knew the irrigation of land well, I shall use his words in describing the management of water on meadows in winter. I shall only premise that there are 2 kinds of water-meadows, one called the *bed-work*, in which the ground is made to decline gently, and the water to flow in the direction of the inclination. The other kind is called *catch-work*, which is only suited to ground having a considerable declivity, and by which the water is brought across the face of the declivity. The object aimed at in both kinds is the greater production of grass. Irrigation, therefore, is one mode of manuring grass-land.

(2052.) "The whole works," as Mr Stephens directs, "being repaired, and there being generally water enough at this season either for the whole or for part, the sluice should be drawn, when, in the course of half an hour, the conductor and the upper part of the feeders will be nearly filled. The first operation of the irrigator is to adjust the water in the conductor; or, if the meadow is in more parts than one, the water in each conductor must be first regulated. Then he commences a-new, by regulating the stops in the first feeder; but should there not be sufficient water in the feeder, a little more must be let in, by making the aperture wider or deeper, till the water flows regularly over the sides from one end to the other. From the first he proceeds to the second feeder, and so on, until the water in all the feeders is adjusted. Let the beds of a water-meadow be ever so well formed, yet, by some places sinking more than others, or by the ice raising the surface of the ground, although the water along the banks of

the feeders has been ever so nicely adjusted, it often happens that there may be some places between the feeders and drains with too little water, when it will be advisable for the manager to make a third round, redressing inequalities of the surface so as to give *every spot* 1 *inch deep of water*. Every part of the works being regulated, the water should be allowed to run through the whole of October, November, December, and January, from 15 to 20 days at a time without intermission. At the expiration of each of these periods, the ground should be made completely dry for 5 or 6 days, to *give it air;* for there are few species of the grasses which form the most nutritive part of the herbage of water-meadows, that will long exist under an entire immersion of water. Moreover, if the frost should be severe and the water begin to freeze, the *watering must be discontinued*, otherwise the whole surface will become one sheet of ice; and *whenever the ice takes hold of the ground, it will undoubtedly draw it into heaps*, which is very injurious to plants." "The object of this early watering of the meadows is to take advantage of the autumnal floods, which bring along with them a variety of putrescent matter, which is found very enriching to land. It is the chief object of the irrigator in those months to collect as much of this manure as possible, and at the same time to shelter the land from the severity of frosty nights. It is therefore requisite to *use as much water as the land will carry without guttering.* I believe it would be difficult to give land, with a dry subsoil and considerable descent, too much water before the weather begins to get warm. It is necessary, in those months, that the meadows be inspected at least once in 3 or 4 days, to see that the equal distribution of the water is not obstructed by the accumulation of weeds," &c.

(2053.) Simple as these directions are, yet the actual management of the water of meadows is not unattended with difficulty, but requires the exercise of good judgment and great attention. "The adjustment of water flowing over the surface of land," remarks Mr Stephens, "for the purpose of improving the herbage, is a *very nice operation;* it requires a perfect knowledge of levels and the vegetation of grasses, and *ought never to be entrusted to an unskilful manager.* When the supply of water is, in any state of the stream that supplies it, sufficient for the whole or one-half of the meadow at once, the management becomes pretty easy; for after the works are cleaned, and the water regulated in the autumn, the sluices should be fixed at such a height as to let in the exact quantity of water required, when it is allowed to run, according to the state of the weather and the season of the year, for 2, 6, 10, or 15 days, without any alteration; and it will be found (unless the water has carried along with it weeds, sticks, or wreck of any kind) to run dur-

ing that whole period nearly as equally over the surface as when first put on. But when the stream is small, and rising and falling with every shower of rain, the management becomes so much the more difficult, that it will require every possible attention of the irrigator to watch and change the water from one part of the meadow to another, or from one bed to another, according to its abundance or deficiency. *Such meadows are indeed ill managed, although half an hour's work in a day would put every thing to rights.* Indeed, let the formation of the meadow be ever so perfect, and the supply of water constant and uniform, yet it is necessary that the manager should survey the whole every 3 or 4 days, to remedy any defect occasioned by the accumulation of weeds, or by a stop being washed away, and thereby cause some places to have too much water, and others too little ; so that, in the former case, the grasses might either be killed or very much injured by the generation of scum, or, in the latter case, there would be little or no produce of grass. Small streams are certainly much more at command than large ; but if the manager, as is too often the case with a young practitioner, vainly endeavour to water too much ground at a time, he may give one part too much water, and another too little ; for on the alteration of the apertures, and adjustment of the water, greatly depends not only the quality but the quantity of the crop."

(2054.) There are many ways of *mismanaging* water-meadows, such as retaining a moist subsoil, or allowing the grass to stand too long before cutting ; but there is an error committed at this period of the year, to which I wish to direct your attention, and which is thus characterized by Mr Stephens. " Another great error generally committed is, allowing the water to run too long at a time, without properly drying the ground. I know some instances where the ground is not attempted to be dried from the time the water is put on the meadows in autumn till 8 or 10 days before the cutting of the hay ; the consequence is, that the grass is of the coarsest quality, and the ground becomes so very boggy, that the whole crop of grass is obliged to be carried by people to some other place to be made into hay. . . . . A water-meadow," adds Mr Stephens, " like a garden, will be good for little without due attention. *All dry soils require more attention than moist ones ;* for if the water in moist soils should not be so nicely regulated as on sandy or dry land, the crop of grass will *not* be so defective as on *porous soils, where the management has been neglected.* I presume that all dry land that has been converted into water-meadows, in countries where the art of irrigation is not well known, and the supply of water not abundant or regular, is liable to more injury, from imperfect treatment, than land

of a moist nature, for plants must have their food at stated times as well as animals, but *this cannot* be the case when the water is irregularly applied."*

(2055.) The mode in which water acts in producing the effects witnessed in water-meadows, has not yet been completely ascertained. It is not the sediment in the water that alone works the charm, for clear water produces similar results; though, no doubt, enriching ingredients carried by the water encourage the growth of plants more rapidly than clear water, as witness the produce of the foul-water meadows in the neighbourhood of Edinburgh. Professor Low has these observations on the theory of the process. "The *theory* of the process of irrigation," says the Professor, "has not been satisfactorily explained. That the effect is not produced by the mere supply of deficient water, appears not only from the period at which the water is admitted, and when in our climate the soil is always saturated with the fluid, but from the circumstance, that *the effect is not produced when the water is allowed to stagnate*, and sink down in the soil, but *when it is kept in a current over it.* When the water is suffered to stagnate, the soil tends to produce carices, junci, and other sub-aquatic plants; but when it is kept in motion, and drained off at intervals, the finest grasses peculiar to the soil and climate are produced. Neither does the fact of the deposition of mud, or other fertilizing sediment, explain the phenomenon; for however such depositions may increase the effect, it is likewise found that water, without the least perceptible sediment, may be employed with success. It has been supposed that the water acts beneficially, by maintaining the soil at a higher temperature. Water, at a temperature of 40°, is of greater specific gravity than at a lower temperature; and hence as the water tends to the freezing point, the warmer portion of it is next the ground. Much, however, cannot be ascribed to this cause, in a current so shallow and constant as that which passes over the watered meadow. It is probable, therefore, that the main effect is produced by a mechanical action of the water, acting upon and bringing nourishment to the fibrous roots of the plants."†

(2056.) Although it may be very true, as Mr Stephens observes, that "however authors may disagree on this interesting subject (the theory of irrigation), I believe all experimentalists acknowledge that early winter watering is necessary to produce early and abundant vegetation; in what way this operates is, as to practical purposes, less material;"‡ yet

* Stephens' Practical Irrigator and Drainer, p. 27–9, 20–2.

† Low's Elements of Practical Agriculture, p. 470, edition of 1838.

‡ Stephens' Practical Irrigator and Drainer, p. 24.

it is always satisfactory to man to be able to give a reason for what he does. To this view I shall add another theory of irrigation, that has been suggested by Professor Rennie, late of King's College, London. It is believed by some vegetable physiologists, that plants excrete certain matter from their roots, which proves inimical to the health of other plants of the same kind. Hence it is concluded that grasses do not continue permanently in a healthy state in the same site, because they are in time injuriously affected by their own excretions, which, encouraging the growth of plants of a different nature, such as mosses, spring up and extirpate the grasses. It is supposed to be probable that *every species of grass is not alike affected by its own, or the excrementitious matter from other grasses*, and therefore some species withstand the poison longer than others. Now the water of irrigation, in its descent through the soil and subsoil, washes away or carries off in solution the injurious excrementitious matter exuded by the grasses, and thereby cleanses the soil, in which they are growing, free of it. Hence the perennial verdure of irrigated meadows.*

(2057.) In order to arrive at a satisfactory explanation of this subject, and believing that both this theory, as well as the one given by Sir Humphry Davy referred to by Professor Low, contain truth, I proposed some time ago a conjunction of the two theories; and the compound theory certainly explains the four great points of irrigation, namely, that it supplies moisture to the soil in dry seasons and in tropical climates; it affords protection to plants against the extremes of heat and cold; it disseminates manure in the most minute manner to plants; and it washes away injurious matter from the roots of plants. The benefits derived from irrigation I therefore maintained are purely mechanical, and doubted the correctness of Sir Humphry Davy's opinion when he says, that "in the artificial watering of meadows the beneficial effects depend upon many different causes, some *chemical*, some mechanical,"† because chemical action only commences *after the act* of irrigation has ceased, as the nature of the following particulars attending irrigation will shew. No doubt, the effects of the substances, whatever they may be, which are deposited by the water of irrigation, may be chemical, as well as those of manure applied to grass by the hand of man. But the act of the water in depositing fertilizing materials, can be no more chemical than that of the instruments used in spreading dung upon the soil. The truth is, that whenever the water of irrigation, or the substances contained in it, act

* Quarterly Journal of Agriculture, vol. v. p. 24.

† Davy's Agricultural Chemistry, p. 305.

chemically upon the grass or soil, while subjected to the process, that moment irrigation proves injurious to the plants. The chemical action and the injury are both evinced by the same phenomenon, namely, the existence of white scum floating on the water. " If the weather should be mild," observes Mr Stephens, " and you suffer the water to run over the meadow *too long without intermission*, a white scum is generated, which *is very destructive to the tender grass*." * The particulars of irrigation I referred to are these :—" The operation of water bringing matter into minute subdivision; the sediment which it contains when used in irrigation being minutely distributed around the stems of the plants; water protecting plants in irrigation against the extremes of heat and cold, by completely covering and embracing every stem and leaf; and the supplying of moisture to the soil and washing excrementitious matter out of it, are all purely mechanical operations." For, " *could the hand of man* distribute manure around the roots and stems of grass as minutely and as incessantly as turbid water; could it place a covering of woollen texture upon each blade and around each stem of grass, as completely as water can embrace each plant and keep it warm; could it water the grass as quietly and constantly as the slow current of irrigation; and could it wash away hurtful matter from the soil as delicately from the fibres of the roots of grass as irrigating water, there *would be no need of irrigation;* the husbandman could then command at will verdant pasturage for his flocks and herds, throughout the year, and in the driest season. *His mechanical* agency would be as effective as irrigation; but constituted as the relative state of things at present are between man and the action of physical laws, he employs irrigation as an instrument of his will, and induces nature to assist him in maintaining his live-stock by an application of her peculiar mode of acting, under his own guidance, but in which she undoubtedly displays her superiority over him, both in perseverance and dexterity." †

* Stephens's Practical Irrigator and Drainer, p. 29.

† Encyclopædia Britannica, seventh edition, art. *Irrigation.*

SPRING.

" Fled now the sullen murmurs of the North,
The splendid raiment of the SPRING peeps forth;
Her universal green, and the clear sky,
Delight still more and more the gazing eye."

BLOOMFIELD.

We have now deliberated upon every topic which the *indoor* operations of the farm, as they may be called, have suggested; and their consideration, to a minute degree, has extended our lucubrations rather beyond their prescribed limits; and yet, when every subject, as it presented itself in succession, was new, and claimed attention, not only on its own account, but as possessing a controlling influence upon those which are to follow, it was requisite to examine particularly into the principles upon which they were based, that the consequent subjects dependent on similar principles may be the more easily understood, and treated according to their nature. I earnestly hope that this may be the result of the deliberations which we have had hitherto together; and I would feel somewhat confident of that issue, if you have bestowed that attention upon the subjects treated of, which they really require.

Upon the whole, we have seen that winter is the season of repose, of passive existence, of dormancy, though not of death. Spring calls forth the opposite emotions; it is the season of revivification, of passing into active exertion, of hope, nay of confidence in what we do will succeed—of hope ripening into fruition as the earnest of prospective plenty is presented in the reproduction of the herds and flocks, and in the world of life which springs into view immediately after the industrious hand has scattered the seed upon the ground. The joy in contemplating such a prospect to the issue of labour is indescribable. I am unequal to the task of describing it, but would not if I could, in case of giving you an unsuitable idea of the enjoyment. I would rather that you should go and enjoy the pleasure for yourself; because " the chosen draught, of which every lover of nature may drink, can be had, in its freshness and

purity, only at the living fountain of nature; and if we attempt to fetch it away in the clay pitchers of human description, it loses all its spirit, becomes insipid, and acquires an earthy taste from the clay."

The weather in spring, in the zone we inhabit, is exceedingly variable, alternating, at short intervals, from frost to thaw, from rain to snow, from sunshine to cloud, very different from the steady character of the arctic spring, in which the snow melts without rain, and the meads are covered with vernal flowers ere the last traces of winter have disappeared. The sky is very clear when the air is free of clouds. The winds are very sharp, when coming from the N. or NE. direction; and they are frequent, blowing strongly sometimes from an eastern and sometimes from a western direction. In the former they are piercing, even though not inclining to frost; in the latter they are strong, boisterous, squally, and rising at times into tremendous hurricanes, in which trees only escape being uprooted in consequence of their leafless state, but by which many a hapless mariner is overtaken and consigned to a watery grave, or dashed without mercy on a rocky shore. The air, when dry, evaporates moisture quickly; and the surface of the ground is as easily dried as wetted. Very frequently snow covers the ground for a time in spring. The severest storms and falls have occurred in February. The memorable falls of the 9th February 1799, and of the 7th February 1823, are yet fresh in the recollection of many persons alive, when, for weeks together, the internal communication of the country was entirely stopt. Roads opened up in one direction were again blocked up immediately after by a drift from the opposite direction. There is something truly awful amongst the hills in a storm of snow in spring. Here is a description of one, true to the life, with all its accompanying prognostics. "One evening, after a day of unwonted tranquillity, dense clouds appear like great snowy mountains in the western part of the horizon, while the few clouds which lie in streaks across the setting sun, are intensely deep in their shadows, and equally bright in their lights. As the evening closes in, the clouds disappear, the stars are unusually brilliant, and there is not a breath of air stirring. The old experienced farmer goes out to take his wonted nocturnal survey of the heavens, from which long observation on the same spot has enabled him to form a tolerably correct judgment of what will be the state of the weather in the morning. Two or three meteors —brilliant, but of short duration—shoot along a quadrant of the sky, as if they were so many bright lights of the firmament, dropping from their orbits. He returns and directs his men to prepare for what may happen, as there will certainly be a change of the weather. The air is perfectly

tranquil when the family retire to their early pillows, to find that repose which healthful labour sweetens and never misses,—

> 'Till rest, delicious, chase each transient pain,
> And new-born vigour swell in every vein.'

But just at the turn of the night the south gives way, the north triumphs, and the whirlwind, herald of victory, lays hold of the four corners of the house, and shakes it with the shaking of an earthquake. But the house, like its inhabitants, is made for the storm, and to stand secure and harmless; while the wind thunders in the fields around, every gust roaring louder than another amongst the leafless branches of the stately trees. In a little its sound is muffled, without being lessened, and the snow is heard battering at the windows for an entrance—but battering in vain. Morning dawns; but every lea and eddy is wreathed up; the snow still darkens the air, and reeks along the curling wreaths as if each were a furnace. For two days and two nights the storm rages with unabated violence; but on the third day the wind has veered more easterly, blows rather feebly, and though the snow falls as thickly, it falls uniformly over the whole surface. This continues for two or three days more; and on the coming of the last of these days, the sun, which has not been visible for nearly a week, looks out just before setting, as if promising a morning visit. The night remains clear, with keen frost, and the wind steady at north, and blowing very gently. The sun rises bright in the morning, the storm is over, and the weather remains unbroken for four or five weeks.

"When the appointed days of the snow-storm are numbered, a disturbance again takes place in the atmosphere, but it is of a different kind from the former. There are little sheets of lightning playing momentarily in the lower atmosphere, and the lustre of the stars is diminished; but still there is no cloud. The wind, however, dies away to a dead calm towards evening, and all is ready for the breaking storm. That operation is the first performed by the Spring, and we shall borrow the words of the 'British Naturalist' wherein to describe it:—'As the spring gets the mastery, which is aided by the condensation which takes place during the night, it rises to a wind, the sound of which cannot be mistaken. The rigidity of trees, window-frames, and other wooden fabrics, through which it passes, is relaxed; the withered grass and reeds, when these are exposed, moisten; and the rattling and thumping are succeeded by murmuring harmony, in which, compared with the other, there is a good deal of music; and as the morning advances and the animals come abroad, and man begins to be active, the hard metallic sounds are

gone, and there is a softness about nature. There is always a delightful transparency about the atmosphere, because the little *spiculæ* of ice are gone, and the heat of the air is too much occupied in converting the snow and ice into water, for changing much of that into vapour. When the change is accompanied by rain, it is far more pleasant at the time, and there is a danger, almost a certain one, that the spring will be treacherous; and that, in consequence of the great heat required for melting the snow, and the evaporation of the rain together, frosts will return long before the process of thawing, so comparatively slow, is completed. The slow melting of snow by rain, compared by that of a warm atmosphere which is constantly shifting by the wind, can be easily understood, when it is remembered that the water which falls, even if it had the temperature of the greatest summer-heat, would be cooled down to the freezing point in melting half its weight in snow. But as the temperature can only be a little above freezing, the water will have the temperature of 32° before it has cooled perhaps $\frac{1}{10}$ of its weight; and as the water is a bad conductor of heat, and great part of the action of the oblique rays of the sun, reflected away from its surface, a rainy breaking of a storm is almost sure to be followed by frost, if it do not happen when the season is far advanced.' In such a situation, and under such circumstances, the storm not unfrequently passes away in what is emphatically termed a *gentle* thaw; and when this is the case, the spring comes under the most favourable circumstances. The snow is dissolved by atmospheric influence alone, without any rain from the clouds; although there are generally light clouds hovering about, ready to produce rain if a returning frost should render a contest of the elements necessary. Besides its rare pleasantness, the gentle thaw is attended with several beneficial consequences. In the first place, there is no flooding of the low grounds, and no washing of the soil from the more elevated ones; but the snow forms a trough for the discharge of the water into which it is melted, and thus the coldest of the snow-water does not reach the surface of the land. In the second place, the water produced by the melting of the snow sinks gradually into the earth, and the earth has been opened to receive a greater store than if it had been pelted by rain during winter. This is occasioned by the radiation of the heat from the lower strata of the earth, which is confined by the snow and turned back again to act upon the earth. In the third place, this last circumstance produces a beginning of the spring under the shelter of the snow, which could not have taken place with free exposure to the atmosphere. The blade of the plant is protected, and the roots have heat and moisture, and the air is excluded from them. They are thus placed under

the most favourable circumstances, and they are stimulated accordingly. The difference in this respect is very considerable; for if, owing to the action of the wind during the fall, or to any other cause, one portion of a field has been exposed to the air while the frost continued, and another covered by the snow, it will be found that vegetation upon the part which the snow covered will be fresh, green, and vigorous, long before that upon the exposed part shews any decided signs of action. This, by the way, is the real cause why spring is so rapid, and meets with so few reverses, where the winter is firm and decided, but of moderate length, than it does when the winter is variable. In such a place as we are alluding to, the spring-wind usually freshens as the snow disappears; and this latter quickens the melting of the snow, and dries the surface of the ground. When the clods begin to dry, the lark soars aloft at the streak of dawn, calling the ploughmen to their labours. Nor are they backward to obey; for they and their teams have been rested during the storm, and then return to their labour with fresh vigour." * I have been the more induced to give this long extract, as, besides containing a true description of a spring snow-storm, it indicates its prognostics, and the peculiar states in which the atmosphere presents itself at this season.

Spring is a busy season on the farm. The cattle-man, besides continuing his attendance on the fattening cattle, has now the more delicate task of waiting on the cows at calving, and providing comfortable lairs for new dropped calves. The dairy-maid commences her labours, not, it is true, in the peculiar avocations of the dairy, but in rearing calves—the supply of a future herd—which, for a time, are indulged with every drop of milk the cows can yield. The farrows of pigs now claim a share in her solicitude. The shepherd, too, has his painful watchings, day and night, on the lambing ewes; and his solicitude and tenderness for the simple lambs, until they are able to frisk and gambol upon the new grass, is a scene of peculiar interest, and insensibly lead to higher thoughts. "When we see the attention of a judicious shepherd upon these occasions, we cannot refrain from thinking of the unspeakable condescension and kindness of Him who 'feeds his flock like a shepherd, gathers the lambs into his arms and carries them in his bosom, and gently leads those that are with young.'" The condition of the fields demands attention as well as the reproduction of the stock. The day now affords as many hours for labour as are usually bestowed at any season in the field. The ploughmen, therefore, know no rest for at least

* Mudie's Spring, p. 266–71. Since I last had occasion to quote Mr Mudie's sentiments on the influence of Winter, p. 104, death has seized the hand of him who was so capable of wielding the pen.

twelve hours every day, from the time the harrows are yoked for the oat-seed until the potato and turnip crops are sown. The beans first demand the ploughmen's aid, and then the lea-ground, turned over at intervals of fresh weather in winter, is ready, with a due degree of drought, to receive its allowance of oat-seed. The turnip land, bared as the turnips are consumed by sheep, is now ploughed across, or ridged up at once for spring wheat, should the weather be mild and the soil dry enough, or else the ridging is delayed for the barley-seed. The fields containing the fallow land now receive a cross-furrow, in the order of the fallow-crops, the potatoes first, then turnips, and lastly the bare fallow. Grass seeds are now sown amongst the young autumnal wheat, as well as amongst the spring wheat and the barley. The field-workers devote their busy hours to carrying seed to the sower, turning dunghills in preparing manure for the potato and turnip crops, and continuing the barn-work to supply litter for the stock yet confined in the steading, and to prepare the seed-corn for the fields. The hedger now resumes his work of water-tabling and scouring ditches, cutting down and breasting old hedges, and taking care to release the sprouting buds of the young quicks from the face of the hedge-bank, fig. 42, which he planted at the commencement and during fresh weather in winter. The steward is now on the alert, sees to the promotion of every operation, and entrusts the sowing of the crops to none but himself, except a tried hand, such as the skilful hedger. Thus every species of labourer has his work appropriated for him at this busy season; and as the work of every one is individually defined, it is scarcely possible for so great a mistake to be committed as that any piece of work should be neglected by all.

The farmer himself now feels that he must be "up and doing;" his mind becomes stored with plans for future execution; and in order to see them executed at the proper time, and in the best manner, he must now forego all visits, and remain at home for the season; or at most undertake an occasional and hasty journey to the market-town to get quit of surplus grain, should the draughts have a leisure day to deliver it. The business of the fields now requiring constant attendance, his mind as well as body becomes fatigued, and, on taking the fireside after the labours of the day are over, seeks for rest and relaxation rather than mental toil. He should at this season pay particular attention to the state of the weather, by observing the barometric and thermometric changes, and make it a point to observe every external phenomenon that has a bearing upon the changes of the atmosphere, and be guided accordingly in giving his instructions to his people.

During a snow-storm in spring, wild-birds, becoming almost famished, resort to the haunts of man. The robin is a constant visitor, and helps himself with confidence to the crumbs cast out for his use. The male partridge calls in the evening within sight of the house in hopes of obtaining a morsel before collecting his covey together to rest for the night upon the snow. In the severe snow-storm of 1823, several covies used to approach my own door at sunset, and oftentimes, ere putting down the sheaf of barley for their nightly meal, at the root of an old beech-tree, the old cocks reminded me of my hospitality, though that was unnecessary in the circumstances, by their loud crisp-like call, before retiring to rest. I believe that, had it not been for this timely supply of nourishing food, they would all have perished in the severity and length of that memorable storm. Hares came to the very door at sunset, and in the moonlight, to receive what food was set down on purpose for them; and so powerful a tamer is hunger of creatures of the most distant habits, that even the wood-pigeons, in large flocks, used daily to frequent an orchard immediately behind the house to pick the curly greens which had grown so tall as to overtop the snow, their favourite food—the Swedish turnip—being then buried out of reach in the snow. The rooks now make desperate attacks upon stacks, and, if allowed, soon make their way through the thatch. Always making their attack at the top, they seem to be aware of the exact place where the corn can be most easily reached. The sparrows even burrow in the thatch, and the lively tom-tit, with a strength and perseverance, one should think, beyond their physical abilities, pull out whole straws from the sides of stacks, to bring the heads of corn within their reach. Farther on in the season the insect world come into active life in myriads, to serve as food for the feathered tribes. Rooks, with sturdy walk and independent gait, diligently search the ground for them, in the wake of the plough, to feed their young therewith. Tom-tits clamber round every spray of trees which indicate an opening of their floret buds. The swallows at length appear, giving animation to the air, and the stream of migration to the northward betokens the approach of genial weather.

"By the time the season is fairly confirmed, the leisure hours of the cottagers," and of ploughmen, who are in fact cottagers of the best condition, are spent, in the evening, "in the pleasing labour, not unaccompanied with amusement, of trimming their little gardens, and getting in their early crops. There is no sort of village occupation which men, women, and children set about with greater glee and animation than this; for, independently of the hope of the produce, there is a pleasure to the simple and unsophisticated heart in 'seeing things

grow,' which perhaps they who feel the most are least able to explain. Certain it is, however, that it would be highly desirable, that not only every country labourer, but every artizan in towns, where these are not so large as to prevent the possibility of it, should have a little bit of garden, and should fulfil the duty which devolved on man in a state of innocence, to 'keep it and to dress it.' It is impossible for any one who has not carefully attended to the subject, to be at all aware how strong the tie is which binds man even to a little spot of his native earth, if so be that he can consider it as his own, and that he himself, and those on whom he loves to bestow it, are to enjoy the fruit. This is the very strongest natural hold which binds a poor man to his country, and to all those institutions established for the wellbeing of society. Shew me the cottage, the roses and the honeysuckles on which are neatly trimmed and trained, and the garden behind is well stocked with culinary herbs and a few choice flowers, and I will speedily find you a cottager who never wastes his time or his money, or debases his mind and learns 'the broad road which leadeth to destruction,' in the contamination of an alehouse. If the garden is neat, one may rest assured that the cottage, however humble it is, is the abode of contentment and happiness; and that however simple the fare may be, it is wealth and luxury in full store to the inmates, because they are satisfied with it, and grateful for the possession of it." * I believe that the contentment of the lot of the Scottish married ploughmen, and of the attachment to the farm upon which they serve, may be traced to the principles evolved in these remarks. No doubt, much yet remains to be done to inculcate on them and their families the advantages of practising habits of personal and domestic cleanliness. Hinds' houses, in this respect, might be much improved, and which, if they were, an air of tidiness and comfort would attend their dwellings, which at present is generally awanting. A great deal depends on the example of the farmer himself; for while he keeps his garden and shrubbery and little avenue in a slovenly manner, it is not to be expected in servants to evince a desire to excel their master. A farmer's garden gets a trimming twice or thrice a-year, and in the mean season, weeds may riot in it without molestation, and its produce may be plucked as best suits the convenience or caprice of the kitchen-maid. Doubtless, considerable crops of vegetables are raised in these gardens, but more through strength of manure than skill of culture. It is, I am aware, inconvenient to obtain the assistance of the professional

* Mudie's Spring, p. 274-5.

gardener in the country when his services may be most wanted; but on a farm on which a hedger is employed, he should be taught as much of gardening as to be able to keep the garden in decent order in the absence of the gardener, whose principal duty should be to crop the ground. A field-worker now and then would keep the weeds in subjection, and allow both the sun and air a freer access to the growing plants.

Towards the end of spring, the farmer thinks of disposing of his fat cattle; but, should he not be offered the price he considers them to be worth, he keeps them on, and even threatens to put them to grass. The dealer and butcher affect to be shy purchasers at this season, knowing there is plenty of fat stock in the country; but, nevertheless, are unwilling to allow a prime lot to slip through their hands, and therefore keep a sharp look-out on all the best lots for disposal. The ready means of steam conveyance to London for fat stock, gives the farmer a vantage ground in his dealings with the butcher, which the latter now knows well to avail himself of by closing a ready bargain on the best conditions he can make.

This is the season, too, for the letting of grass-parks. These usually belong to landed proprietors, and form a portion of their park and lawn. The ready market which these parks meet with, induces the retention of such ground in permanent grass, while it places their owners beyond the risk of speculation in the purchase of grazing cattle on their own account. It is not customary for farmers to let their grass-parks, except in the neighbourhood of large towns, where cowfeeders and butchers tempt them with high offers, which they accept rather than purchase cattle, whose feeding may not be repaid. Pasture for grass is, in truth, so convenient for the stock of those classes of people, that they will almost give any rent rather than be deprived of the convenience. In regard to the effect which letting of grass-parks by tenants has on the rights of the landlord, I may mention that his "hypothec extends over the crops and live stock of the tenant, including horses, cows, sheep, cattle, and every description of stock *raised on the farm*, but it does *not extend to the cattle of others taken in to graze*. On this ground, it has been held an irritancy of the lease, should the tenant, instead of stocking the farm, take in cattle to graze, and thereby give the landlord no security for his rent. (Mackye, December 4. 1780, M. 6214.)" * Facility of obtaining grass-parks in the country is at times useful to the farmer who raises grazing stock, in one of which, at least, he may give

* The Farmer's Lawyer, p. 46.

them a better bite or warmer shelter than he can perhaps offer on the division of his farm which happens to be in grass.

The landed proprietor has to seek another market in spring, one for his timber which he annually fells in thinning out his plantations. These sales afford convenient supplies to farmers who may be in want of paling for fencing new hedges, wood for sheep-flakes or stabs, or timber for the erection of shedding for animals, or for implements. They are also serviceable to country joiners and implement-makers, in supplying them with necessary materials nigh at hand. The timber is felled by the owner, and assorted into the sizes and kinds of lots which he knows will best suit the local demand. Prunings and small thinnings are sold as fire-wood, and purchased by villagers who cannot afford to purchase coal, and by farmers who have to supply fuel to bothies. After this *resumé* of spring-work, let us now particularly consider each operation in its proper order.

---

46. OF COWS CALVING, AND OF CALVES.

"When she has calved, then set the dam aside,
And for the tender progeny provide."

DRYDEN'S VIRGIL.

(2058.) The first great event in spring, on a farm of mixed husbandry, is the *calving of the cows;* not that this event should not occur till spring —though most breeders of farm-stock are anxious to have calves early, particularly bull calves (1458.), and on that account calves are born as early as December and January—but by far the greater proportion of the stock of cows are not desired to begin to calve till February, and the season of calving continues in good time till the middle of April; after which, as in May, the calves are accounted late, and then seldom retained as a part of the *breeding*-stock, namely, that portion which is specially set aside to propagate its kind. Reluctance to late calves arises from no objection to their purity of breeding, for earliness or lateness of birth can have no effect in that respect; but chiefly because an early calf possesses the advantage of having passed through its period of milking in time to be supported on grass, as soon as it affords a plentiful supply of food. From 8 to 10 weeks at this season is a period of great anxiety for the state of the cows; and, indeed, till her calving is safely over, the life of the most valuable cow is in jeo-

pardy. Every solicitude, therefore, that can conduce to her passing in safety over this critical period, ought to be cheerfully bestowed.

(2059.) You may remember the treatment which I recommended some time ago for cows in winter, in reference to food and exercise, in (1435.) and (1438.). When the cow first shews heavy in calf, which is usually after her 6th month, the litter in the court should not be allowed to become too deep, as over-exertion in walking over soft loose litter and dung, may cause such an excited action of the animal's system, and most probably of the womb, as to make her slip calf, —or to *slink the calf*, as it is usually termed. The litter in a court which is constantly trampled by cattle at freedom, becomes so firm as to afford a good footing; but the case is different in a cows'-court, which is usually filled with loose litter wheeled from the byre; and as it is walked upon only for a short time every day by cows, which, when in calf, are not disposed to roam much about, it never becomes firm. To render the litter as firm as may be under the circumstances, the cattle-man should spread each barrowful as he wheels it out, taking care to mix a due proportion of straw with the dung.

(2060.) Cows, as they calve, and after it is considered safe for them to go out in the air again, should not be allowed to go into the court at the same time with those yet to calve; because calved cows soon *come into season*, as the phrase has it, that is, soon become desirous of the bull; and when they approach this condition, there is a very prevalent desire on the part of the other cows to ride upon them, and, what is remarkable, especially of those yet uncalved. As may be supposed, such violent exertions, made on soft litter, are likely to produce injurious results on the uncalved cows, by even causing inversion of the calf in the womb, by bringing on febrile action, or by causing the slipping of the calf. The time of the day at which cows in these different conditions should go out, may be left to the discretion of the cattle-man, who should, however, keep this consideration in view, that as cows, after having calved, become more tender in their habit than before, they should enjoy the best part of the day; for instance, from 12 to 2 o'clock.

(2061.) *Cows may be ascertained to be in calf* between the 5th and 6th months of their gestation. The calf quickens at between 4 and 5 months; and up to that period, no disagreeable change has been caused in the constitution of the cow; but from this period she becomes subject to several diseases. The calf may be felt by thrusting the points of the fingers against the flank of the cow, when a hard lump will bound against the abdomen, and the feeling will be communicated to the fingers. Or when a pailful or two of *cold* water is drank by the cow,

the calf kicks, when a convulsive sort of motion may be observed in the flank, by looking at it from behind, and, if the open hand is then laid upon the space between the flank and udder, this motion may be most distinctly felt. But it is not in every circumstance that the calf can be felt at so early a period of its existence; for when it is lying in a natural position in the interior of the womb, it cannot be felt at all; and when it lies near the off or right side of the cow, it is not so easily felt as on the opposite side. So that, although the calf cannot be *felt* at that early stage, it is no proof that the cow is not in calf. Some cow-dealers shew great acuteness in ascertaining whether a cow is in calf. One, whom I knew, that was bred a tailor, told me that when a resinous-looking substance could be drawn from the teats by stripping them firmly, the cow is sure to be pregnant. After this period the flank in the near side fills up, and the general enlargement of the under part of the abdomen affords an unequivocal symptom of pregnancy.

(2062.) The *womb* of the cow is a bag of irregular form, having a chamber or division attached to each side called the *horns of the womb*, and so called, perhaps, because of the form they present in an unimpregnated state, of the large curved horns of a black-faced tup. The womb consists almost entirely of muscular fibres, with a large proportion of bloodvessels, and of cellular matter, which admits of contraction and extension. Its ordinary size in a large cow is about $2\frac{1}{2}$ feet in length, but when containing a full-grown fœtus it is 7 feet in length. This is an extraordinary adaptation to circumstances which the womb possesses, to bear an expansion of 7 feet, from about $\frac{1}{3}$ of that length, and yet be capable of performing all its functions. The use of the horns seems to be to form a lair for the calf, and each is occupied by the calf according to its sex. The quey-calf occupies the near, and the bull-calf the off-side horn. So that a quey-calf is more easily felt in the younger stage than a bull-calf; and indeed the latter is frequently not felt at all until the 7th month, when other symptoms afford proofs of pregnancy.

(3063.) The exact time of a cow's calving should be known to the cattle-man as well as by the farmer himself, for the time when she was served by the bull should have been marked down. Although this last circumstance is not a certain proof that the cow is in calf, yet if she passes the period when she should take the bull again without shewing symptoms of season, it may be safely inferred that she became in calf at the last serving, from which date should then be calculated the period of gestation, or of *reckoning*, as it is called. A cow generally goes 9 months, or 273 days, with calf, although the calving is not certain to a

day. Nay, she sometimes goes as much as 3 weeks over her time, but far more frequently only 9 or 10 days. When a cow passes her reckoning for a number of days, she will be found most commonly to bear a bull-calf.

(2064.) Cows are most liable to the *coming down of the calf-bed*, to which I formerly referred (1520.), when near the period of calving, between the 8th and 9th months, and, from whatever cause it may originate, the position of the cow in which she lies in her stall should be attended to, by keeping her hind part as high as the fore, by raising the litter. The immediate cause of the protrusion of a part of the womb is the pressure of the calf's fore feet and head against that part of it which is opposite to the vaginal passage, and the protrusion mostly occurs when the calf is in its natural position; so that no great danger is to be apprehended from the protrusion, although it is better to use means to prevent its recurrence, which is an *unnatural* occurrence, than to trust to consequences by over-confidence.

(2065.) Much more care should be bestowed in administering food to cows near the time of their reckoning, than is generally done; and the care should be proportioned to the state of the animal's condition. When in high condition, there is much risk of inflammatory action at the time of parturition. It should, therefore, be the farmer's care to check every tendency to obesity in time. This may partly be effected by giving fewer turnips and more fodder than the usual quantity; but some cows when in calf, and have been long dry, will fatten on a small allowance of turnips; and there is this disadvantage of administering food in too dry a state, that it tends to aggravate one of the tendencies of the system you are attempting to check, namely, the inflammatory. Other means must therefore be used, alongst with a limited allowance of food, and, in as far as medical treatment can be applied to the case, there is perhaps nothing so safe as bleeding and laxatives. "Every domestic animal like the cow," observes a very sensible writer on this subject, "is to be considered as by no means living in a state of nature. Like man himself, she partakes of civilized life, and of course is subjected to similar infirmities with the human race. The time of gestation is with her a state of indisposition, and every manager of cattle should be aware of this, and treat her with every attention and care during this time. The actual diseases of gestation are not indeed numerous, but they are frequently very severe, and they occasion always a tendency to slinking, or the cow slipping her calf. As the weight of the calf begins to increase, it will then be necessary to take some pre-

cautions, and these precautions will consist in an attention to her diet, air, and exercise."*

(2066.) It is the 8th and 9th months that constitute the critical period of a cow in calf. The bulk and weight of the fœtus cause disagreeable sensations in the cow, and frequently produce feverish symptoms, the consequence of which is costiveness. The treatment for this is bleeding once or twice, in proportion to the strength and condition of the cow, and the administering of laxative medicine and emollient drinks, such as a doze of 1 lb. of Epsom salts with some cordial admixture of ginger and carraway and treacle, in a quart each of warm gruel and sound ale. Turnips, of course, are given, and they have a laxative tendency. Potatoes, too, are recommended; but I confess I entirely object to giving potatoes to cows at any time, because of their great tendency to produce hoven, of which, if an attack were to overtake a cow far advanced in calf, would either kill the calf in the womb, or cause the cow to slip it. Turnips, though perhaps not of so laxative a nature as potatoes, are yet much safer; though it is quite true that Swedish turnips, at the season of the year when cows calve, are solid in their texture, and have less sap in them, and are therefore more binding in their nature, but on account of these properties they are the better adapted for feeding. In cases of indigestion, consequent on inflammatory action, I have seen the substance of this turnip in the maniplies, or third stomach, squeezed flat like the husks of apples from a cider press.

(2067.) Having suffered the loss of two or three cows by costiveness, immediately after calving, I was induced to try *oil-cake* as a laxative along with the Swedish turnip. The cake was given to the cows for 2 months, one before and one after calving, and its valuable property of keeping the cows in a fine laxative state, and at the same time in high health, was truly satisfactory; and on continuing the practice every year afterwards, a similar mishap never overtook my cows. The quantity given to each cow daily was 4 lb., at an intermediate time between the feeds of turnips. The time of giving it was as regularly adhered to as that of the turnips, and when the hour arrived, at 10 o'clock in the forenoon, for its distribution, every cow expressed the greatest anxiety for the treat. It was broken to them in small pieces with a hammer, which is a tedious manner of breaking it when a number of cattle are supplied with it at a time; but the process can be easily and expeditiously performed by the use of the oil-cake breaker, fig. 264.

(2068.) But the opposite state to obesity is also to be avoided in cows

* Skellett on the Parturition of the Cow, p. 41.

in calf, namely, that of weakness and empoverishment of condition. In such a case, bleeding of course is improper, and the cow should rather have good and nourishing food, such as mashes of boiled barley, and turnips, and oil-cake, not given in large quantities at a time, but frequently and moderately, with a view of laying on flesh in a gradual manner, and of avoiding the fatal tendency to plethora. I believe he who gives oil-cake to his cows before and after their calving, as I have recommended, need entertain no apprehension of their safety in as far as regards their calving, in whatever condition they may happen to be, because it proves a laxative to the fat, and a nourishing article of food to the lean cow, and in both secures a proper state of all the parts connected with calving.

(2069.) *Slinking*, or slipping calf, is both a vexatious occurrence and a great loss to the breeder of stock. It is not only a loss of the calf itself, but the want of it makes a blank in the number of the lot to be brought up in the season, and which must be made up by purchase. And it is a very vexatious occurrence in a cow that is desired to be kept as a brood cow, inasmuch as she never can again be depended upon to bear a living calf, the probability being that she will slip every calf afterwards at one time or another of her gestation. Why this should be, has never been satisfactorily explained, though the fact is undoubted. The only plan for the farmer to avoid a future disappointment by such an untoward event, is to draw the milk from the cow as long as she gives it, and then fatten her for the butcher. I had a very fine short-horn cow, bred by myself, that slipped her second calf; and not being disposed to trust her again, fed her off, when she became extraordinarily fat, and yielded very superior meat; and this was the only cow I ever had which was a victim to the complaint we are speaking of. This is the same cow that I referred to before, as having yielded so great a quantity of tallow, (1544.).

(2070.) The *causes* of this troublesome complaint are various, arising chiefly, however, from violent exercise, the effect of frights, bruises, and knocks; "but," says Skellett, "a more common cause of slinking than any of them, and which is peculiar on the influence of this animal, is a disagreeable *nauseous smell;* the cow is remarked to prepossess a very nice and delicate sense of smelling, to that degree, that the slinking of one cow is apt, from this circumstance, to be communicated to a great number of the same herd: it has been often known to spread like an infectious disease, and great losses have been suffered by the cowfeeders from the same."* If there is any truth in the last cause mentioned in

* Skellet on the Parturition of the Cow, p. 62.

producing the complaint, and which I believe to be true, as I know that cows are endowed with a very delicate sense of smell, you will require no arguments to convince you of the necessity of keeping every thing in a byre *occupied by breeding cows* in a clean and wholesome state; to have every particle of filth removed daily from the feeding troughs before and the urine-gutters behind them; and to have the byre thoroughly ventilated when the cows go out to the court. The same circumstance will shew you the propriety of preventing any pig being slaughtered on the litter on which cows are accustomed to walk, and of not allowing any animal to be bled, and of any blood to be spilt near the byre. When any of the cows require bleeding, the operation should be performed in a different apartment from the byre.

(2071.) Whenever a cow shews symptoms of slinking, which may be observed in the byre, but not easily in the grass-field, she should be immediately removed from her companions. The *first symptoms are* a sudden filling of the udder before the time of reckoning would warrant, a looseness and flabbiness and redness of, and a yellow glairy discharge from, the vagina, and a giving way of the ligaments or couples on each side of the rump. When any of these symptoms are observed, the cow should be narrowly watched, and means of preventing slinking instantly adopted, one of the chief of which is bloodletting. This should be followed by a laxative doze. But these means may prove ineffective if the symptoms made their appearance suddenly, and went through their course rapidly, and the calf be slipped after all.

(2072.) The risk which the cow runs, after slinking, is *in not getting quit of the cleaning*, or *afterbirth*, or *placenta*, because in such a case it is in an unprepared state to separate from the womb. Should it be retained, a certain degree of corruption is apt soon to take place in it, which will produce a very nauseous smell, that may remain for some time, as the cleaning may only pass away by degrees by putridity. Whenever the cleaning does not come away in the course of a few hours, or at most a day, the assistance of the veterinary surgeon should be obtained. The following cordial drink will promote the cleansing; juniper berries 3 oz., bay berries 2 oz., nitre 1 oz., anise seed 1 oz., gentian ½ oz., gum myrrh ½ oz., assafœtida ½ oz., well pounded together, for 1 dose, and given in 1 quart of mild ale made warm in 1 quart of pennyroyal tea. This drink should be given fasting, and repeated every day till the cleansing is evacuated.*

* Skellett on the Parturition of the Cow, p. 67.

(2073.) After such a mishap the cow should be kindly treated in her diet, by the administration of mashes, gruels, and cordials, and her bowels kept in an open state at the same time, until her system recover its tone.

(2074.) As to the *prevention* of the recurrence of this vexatious complaint, though I believe that the best thing for the farmer is not to attempt any, but just to milk and fatten the cow, yet as a natural desire may be felt to retain a valuable and favourite cow, I shall mention some means which may be used, and which may have the effect of enabling the cow again to bear a living calf; and there is certainly this inducement to try means, that after the womb has again assumed its healthful tone, so as to retain the fœtus till the proper time, there is a probability of the complaint not returning, provided the following means are used every season during the period of gestation. Skellett mentions these preventive measures. "When a cow has slipped her calf, in the next gestation she should be early bled, her body should be kept open by cooling physic; she should not be forced to take any more exercise than what is absolutely necessary for her health, and her interfering with other cattle guarded against by keeping her very much by herself. At the same time," he adds, "it must be observed, that though it is necessary to preserve a free state of the bowels, a laxity of them will often produce this accident; cows *fed very much upon potatoes*, and such other watery food, *are very apt to slink*, from their laxative effects. In the food of the cow, at this time, a proper medium should be observed, and it should consist of a due proportion of other vegetable matter mixed with the fodder, so as the bowels may be kept regularly open, and no more." Our author, however, does not see that these remedial measures can be very useful. If the cow is in high condition indeed, she should be reduced in condition; if she is very low, she ought to get nourishing food and strengthening medicines, and if she is much annoyed by nauseous smells, these should either be counteracted, or the cow withdrawn from them. To counteract bad smells, Skellett recommends the following mixture to be formed, and rubbed a little every day on the parts the cows commonly smell each other:—Barbadoes tar, 3 oz., balsam of sulphur, 3 oz.; rectified oil of amber, 1 oz.; fine oil of thyme, 1 oz.; and animal oil, 1 oz. "Of what nature that odour is," continues Skellett, "which gives offence, we cannot altogether be certain; but the author has remarked that its effects occur at one season more than at another, and particularly when the weather has been wet, and the cows have long been kept at grass. From this fact," he concludes,

"it will appear that the smell is of a vegetable nature, and connected with their feeding at that time."* It is understood that cows that are fed in the neighbourhood of and in woods, and that live on coarse rank pasture in autumn, are most liable to this complaint. In Switzerland, the complaint increases after the cows are put on rank pastures in autumn.

(2075.) Though slinking is spoken of as an infectious complaint, it has no property in common with any contagious disease; but sympathetic influence being a main cause of it, its result is as fatal as if direct contagion had occasioned it.

(2076.) About a *fortnight before the time of reckoning, symptoms of calving indicate themselves* in the cow. The loose skinny space between the vagina and udder becomes florid; the vagina becomes loose and flabby; the lower part of the abdomen rather contracts; the udder becomes larger, harder, more florid, hotter to the feel, and more tender-looking; the milk-veins along the lower part of the abdomen become larger, and the coupling on each side of the rump bones looser; and when the couplings feel as if a separation had taken place of the parts there, the cow should be watched day and night, for at any hour afterwards the pains of calving may come upon her. From this period, the animal becomes easily excited, and, on that account, should not be allowed to go out, or be disturbed in the byre. In some cases, these entire preparatory symptoms succeed each other rapidly, in others they follow slowly; and the latter is particularly the case with heifers with the first calf. These symptoms are called *springing* in England, and the heifers which exhibit them are *springers*.

(2077.) In different parts of the country, different practices exist in regard to attending on cows at calving. In the southern counties of Scotland, the shepherd conceives it to be his duty to attend on the occasion, assisted by the cattle-man, and other men if required. In the northern counties, on the contrary, the calving is left to women to manage. I think this difference in practice must have arisen from the *degree of assistance* required at the operation. In the southern counties, the large class of cows almost always require assistance in parturition, the neglect of which might cause the cow to sink from exhaustion, and the calf be strangled or drowned at its birth. Powerful assistance is sometimes required and can only be afforded by men, the physical ability of women being unequal to the task. Indeed, I have witnessed the assistance of 8 men, in one way and another, given in the extraction of a calf coming even in a natural position. The calf was

* Skellett on the Parturition of the Cow, p. 74.

the first of twins, was very large, and this was the first labour of the heifer. I shall never forget the distressing cries of the poor creature when racked with pain, nor the patience and sympathy evinced by all the men who were summoned to assist. It was an interesting case, conducted by an experienced shepherd, and lasted altogether about five hours. The cow and calves were much exhausted; but all recovered in the course of a few days. In the northern counties, cows are not only smaller, but their calves are smaller in proportion, so that most cows calve without assistance; and, therefore, women may manage both cow and calf without difficulty. Of the two modes of conducting this delicate and oft times tedious operation, I should say that it falls most legitimately under the guidance of the shepherd, who seems to be the natural guardian of all the young stock brought forth on a farm; and where there is no shepherd, the cattle-man should take the charge, the farmer himself, in all cases, giving his sanction to the means about to be used, as it is but fair that he himself should bear the heaviest portion of the responsibility connected with this dangerous procedure.

(2078.) There are a few preparatory requisites that should be at hand when a cow is about to calve. Two or three rein-ropes are useful, to fasten to the calf if necessary,—a *flat soft* rope being the best form, but common rein-ropes will answer. A mat or sheeting, to receive the calf upon in dropping from the cow, should she be inclined to stand on her feet when she calves. The cattle-man should have a calf's crib in R, fig. 3, Plate III, well littered. The shepherd should pare the nails of his hands close, in case he should have to introduce his arms into the cow to adjust parts; and he should supply himself with goose-grease or hog's lard to smear his hands and arms. Goose-grease is best for making the skin smooth, and withstanding evaporation (1719.). It may be that a few sacks may have to be put under the cow to elevate her hind quarter, and even block and tackle may be used to hoist her up by the hind legs, in order to adjust the calf in the womb. These last articles should be ready at hand if wanted. A little straw should be spread on the floor of the byre, to place the new-dropped calf upon.

(2079.) All being thus prepared, and the byre-door closed to keep all quiet, the cow should be attended to every moment. The symptoms of calving are thus exactly described by Skellett, as they occur in an easy and ordinary case. "When the operation of calving actually begins," he says, "then signs of uneasiness and pain appear: a little elevation of the tail is the first mark; the animal shifts about from place to place, frequently getting up and lying down, not knowing what to do with herself. She continues some time in this state, till the natural

throes or pains come on; and as these succeed each other in regular progress, the neck of the womb, or *os uteri*, gives way to the action of its bottom and of its other parts. By this action, the contents of the womb are pushed forward at every throe; the water-bladder begins to shew itself beyond the shape, and to extend itself till it becomes the size of a large bladder, containing several gallons; it then bursts, and its contents are discharged, consisting of the *liquor amnios*, in which, during gestation, the calf floats, and which now serves to lubricate the parts, and render the passage of the calf easier. After the discharge of the water, the body of the womb contracts rapidly upon the calf; in a few succeeding throes or pains, the head and feet of it, the presenting parts, are protruded externally beyond the shape. The body next descends; and in a few pains the delivery of the calf is complete." * The natural and easy calving now described is usually over in 2 hours, though sometimes it is protracted 5 or 6, and even so long as 12 hours, particularly when the water has been easily evacuated, or the water-bladder has broke before being protruded beyond the shape or vagina.

(2080.) But although the calf may present itself as here described in its natural position, with both its fore-feet projecting, its chin lying on both fore-legs, and the point of the tongue sticking out of the side of the mouth, it may not be extracted without assistance; and as the feet of the calf are too slippery to be retained hold of by the hands, a rein-rope is doubled, and a folding loop at the double is passed up above each fetlock joint, from whence the double rope from each leg is ready to be taken hold of by the assistants. The pull should only be given at each time the cow presses to get quit of the calf, and it should be steady but firm, in a direction down from the back of the cow, and a little more than sufficiently strong to keep good whatever advance the calf may have made. Meantime the shepherd endeavours to relax the skin of the cow around the calf's head, by manipulation, as well as by anointing with goose grease, his object being to pass the skin over the cantle of the calf, and when this is accomplished, the whole body may be drawn gently out. In obstinate cases of this kind, a looped rope may be passed across the mouth of the calf round the under jaw, which will facilitate the passage of the head; but this should not be resorted to but on necessity, the cord being apt to injure the tender mouth.

(2081.) On the extrusion of the calf, the first symptom it shews of life is a few gasps which set the lungs in play, and then it opens its eyes, and tries to shake its head, and sneer with its nose. The breathing is

* Skellet on the Parturition of the Cow, p. 105.

assisted if the viscid fluid is removed by the hand from the mouth and nostrils; and the thin membrane which envelops the body in the womb should now be removed, much torn as it has been in the process of parturition. The calf is then carried by two men, suspended by the legs, with the head held up between the fore-legs, and the back downwards, to its comfortably littered crib, where we shall leave it for the present to attend still farther on its mother.

(2082.) The presentation is sometimes made with the *hind-feet foremost.* At first the hind-feet are not easily distinguished from the fore, but if a hind presentation is made in the natural position of the body, that is, with the back uppermost, the hind-feet will be in an inverted position to the fore, that is, the soles will be found uppermost instead of the hoofs. There is no difficulty with a hind presentation, only it should be ascertained that the tail is in its natural position, and not folded up, before the legs are pulled out. The first obstructing point is the rump, and then the thickest part of the shoulder. On drawing out the head, and coming last, it should be pulled away quickly, in case the calf should give a gasp for air at the moment of leaving the cow, when it may inhale some of the water instead of air, and run the risk of choking. The mouth and nose should be wiped immediately.

(2083.) Some have a custom, which is particularly practised by women, to rub the skin of the new-dropped calf with a wisp of straw, but such a species of dressing should not be allowed, as it serves only to agglutinate the hair with the liquor amnios which is brought along with it. If left to itself, the liquor evaporates in a short time and leaves the hair dry; but while the evaporation is proceeding the calf trembles, no doubt from feeling it cold, and on this account, if for no other, the litter in which it is first laid should be soft, clean, and amply sufficient to bury its body out of sight. I may mention, however, that the trembling is considered a happy symptom of the strength of the calf.

(2084.) All yet has been easily managed, when the cow lies still in her stall, with plenty of straw around and behind her hind-quarter; but some cows are of so restless a disposition that they will not lie still to calf, and whenever the pains seize them, up they start to their feet, and when they cease lie down again. Such a cow is troublesome to deal with, as it is scarcely possible, by reason of her risings up and lyings down, to ascertain the true position of the calf, especially when it does not present itself in the natural position. In such a case, it is the more necessary to extract the calf energetically, and remove the uneasiness of the cow, for, till she gets quit of it, she will not settle in one position or another. When the calf is so near the external air as to enable the operator to get

the ropes round its legs, whether fore or hind, and a gentle pulling commenced, to fix her attention to the object in view, she will press with great force, the standing position giving her additional advantage, so that the extraction of the calf, in such a case, is generally the most expeditious. As in this position of the cow the calf will have to fall from a considerable height to the ground, and may thereby be hurt, it is necessary to be provided with a mat or chaff-sheet, which two men hold below the body of the calf, ready to receive the body upon it when it leaves the cow. I had a short-horn cow that was very troublesome at calving, remaining but a short time up or down, and being the whole time in the greatest state of excitement. She always stood to calve, but when the process was actually begun, she pressed with so much vigour that she got quit of it in a few minutes. Upon one occasion, after the water had come from her, the shepherd was preparing the ropes to be in readiness in case they should be required; but while employed at them, and within a couple of yards from the cow in her stall, she gave such a powerful press as to project the calf from her, and it fell upon the floor, but luckily upon the very straw that had been laid down to receive it. This instance shews the necessity of careful watchfulness on cows after symptoms of actual calving have begun, as in such a case as I have just narrated, entire neglect might afterwards have found the calf killed or injured by the heavy fall it had received.

(2085.) Some calves, though extracted with apparent ease, appear as if dead when laid upon the straw after birth. When such a case occurs, the hand should be placed against the side of the breast, to ascertain if the heart beats; which, if it does, there is of course life, and all that is wanted is to inflate the lungs. To accomplish this, the mouth and nose should be cleaned, the mouth opened, and if there still be no breathing, some one should blow steadily into the open mouth, a device which I have seen answer the purpose; as also a hearty slap of the open hand upon the buttock of the calf, which starts it, as it were, into being. Perhaps a bellows might be usefully employed in such a case, to inflate the lungs. Should no beating of the heart be felt, and yet consciousness of life seems to be there, the calf should be carried without delay to its crib, and laid down and covered up with the litter, leaving the mouth free to breathe, and it may survive; but even after giving a few gasps, it may die. Most probably the cause of its death may be from injury it had received in calving, such as long detention in the vaginal passage, or an undue squeeze in passing through the mouth of the womb, or by some rashness of the operator.* The body of the calf when thus lost

should be skinned while warm; it should be cut in pieces, and buried in compost for manure, and the skin sold.

(2086.) The difficult cases of presentation which usually occur are with one foot and the head, and the other foot drawn back, either with the leg folded back altogether, or the knee doubled and projecting forward. In all of these states the missing leg should be brought forward. To effect this, it is necessary to put round the presented foot a cord to keep it within the power of the operator when the head is pushed back to get at the other foot, and the greased arm of the operator introduced, and the foot brought forward into the passage beside the other. A calf may be extracted with one leg folded entirely back alongside the body, and on feeling this to be the case, it is perhaps better to extract the calf at once, than to delay the parturition in attempting to bring forward the leg. The presentation may be of the head alone without the feet, which may be knuckled forward at the knees, or folded back along both sides. In the knuckled case both legs may be brought forward by first pushing the head back, but, in case of losing hold of the calf altogether, a loop should be put in the calf's mouth. In the folded case, one leg at least, but both if possible, should be brought forward. A worse case is, when one or both legs are presented and the head folded back into the side. In this case the calf will most likely be dead. The head should be brought forward, and both legs if possible. It may be beyond the strength of the operator to bring forward the head; then he should put a loop into the calf's mouth, by which his assistants will pull forward the head. Still worse cases may occur, such as a presentation of the shoulder, with the head lying into the side; a presentation of the buttock, with both the hind legs stretched inwards. Or the calf may be on its back, and making presentations in all the worst features now enumerated. In whichever of these states the calf may present itself, no extraction can safely take place until it is placed in a position by which the head and one of the legs, with the other folded entirely back, or both the hind legs, with the back turned uppermost, are secured. In no case, however, should a fore or hind leg be left so as not only to obstruct the body in leaving the mouth of the womb, but a foot left so much at liberty as to tear the womb. The *safest* practice therefore is, to secure both legs as well as the head. This may cause the operator considerable trouble, but by retaining hold of what parts he can with cords, and dexterity in handling the part amissing, so as to bring it forward to the passage, whilst the assistants pull as he desires, his object will in most cases be attained; but it should be borne in mind that none of all these objects can be attained but by the assistance

of the cow herself, that is to say, they should only be attempted when seconded by the throes of the animal. If this circumstance is not attended to and patiently watched by the operator, the muscular grasp of the womb will render his arm powerless. Another facility that should be taken advantage of by the operator is, that when the hind-quarters of the cow has an inclination downwards, she has the power to press the stronger, and of course to counteract his efforts the more easily. What should be done, therefore, is to raise that quarter of the cow with bundles of straw fully higher than the fore-quarter, until he has got the calf in the position he desires, and then, by letting the cow down again, and watching her pressings and assisting her at the same time, but not otherwise, the extraction may be accomplished in a reasonable time. As to block and tackle, the expedient should never be resorted to but to save the life of the cow, and as to *turning* the calf in the womb, there is far more danger in the attempt of injuring the womb than the value of the calf is worth. Much rather destroy it and cut it away in pieces, than run the risk of losing the cow. When the head only of the calf has found its way into the mouth of the womb, and cannot be protruded through the vagina, by reason of the unfavourable and obstructive position of the fore legs, an inspection should immediately be made of the position of the calf, by first thrusting the head back with a loop in the mouth, and bringing the legs forward. When this inspection has been too long delayed, and the head kept confined in the passage, the violent throes of the cow will certainly strangle the calf, and its head will swell to an inordinate degree. In such a case, as the swelling will prevent the calf's head being pushed back to get at the legs, it must be taken off, the legs brought forward, and the body then extracted. One of the most difficult cases is, when the fore feet are presented naturally, and the head is thrust down upon the brisket between the legs. The feet must first be pushed back, and then the head brought up and forward, and the extraction will then become natural.

(2087.) A skilful shepherd may be able to manage all these difficult cases within a reasonable time; but unless he is particularly dexterous at cases of parturition, it is much safer to obtain the advice of a veterinary surgeon, even although he should not be required to put a hand to the operation himself. In the case of extracting monstrosities, his assistance is indispensable.

(2088.) In regard to extracting twin calves, before rendering the cow any assistance, it is necessary to ascertain that the calves have made a proper presentation; that they are free of each other; that one member of the one is not interlaced with, or presented at the same time with,

that of the other. When they are quite separated, then each can be treated according to its own case.

(2089.) Calving in a byre does not seem to produce any disagreeable sensations in the other cows, as they express no surprise or uneasiness in regard to what is going on beside them. When the cow gives vent to painful cries, which is rarely, the others no doubt express a sympathy; and when the calf is carried away, they may exhibit some restlessness; but any commotion arising from these circumstances soon subsides. But if a difficult labour is apprehended, it is better for the cows, and also for the cow herself, that she be delivered in another apartment, well littered, where the operator and his assistants can have free access to her.

(2090.) A notion exists in some parts of England, that a cow, when seized with the pains of labour, should be made to move about, and not allowed to lie still, though inclined to be quiet. "This proceeds from an erroneous idea," Skellet well remarks, "that she will calve much easier, and with less danger; but so far from this being the case, the author has known a great many instances where the driving has proved the death of the animal by overheating her, and thus producing inflammation, and all its bad consequences. Every rational man will agree in opinion with the author, that the above practice is both cruel and inconsistent in the extreme; and this is confirmed by what he has noticed, that the animal herself, as soon as the pains of calving come on, immediately leaves the rest of the herd, and retires to some corner of the field, or under a hedge, in order to prevent the other cows, or any thing else, coming near, that may disturb her in bringing forward her young."* In short, too much gentleness cannot be shewn to cows when calving, and they cannot be too strictly guarded against every species of disturbance. The shepherd will not allow even his dog to enter the byre when calving is going on.

(2091.) The *afterbirth*, or placenta, does not come away with the calf, a portion of it being suspended from the cow. It is got quit of by the cow by pressing, and, when the parturition has been natural and easy, it seldom remains with her longer than from 1 to 7 hours. In bad cases of labour it may remain longer, and may only come away in pieces; but when it remains too long and is sound, its separation will be assisted by attaching a small weight to it, say of 2 lb., which, with its continued force, and occasional pressing from the cow, will cause it to drop. The usual custom is to throw the afterbirth upon the dung-

* Skellett on the Parturition of the Cow, p. 113.

hill, or it is covered up with the litter; but it should not be allowed to lie so accessible to every dog and pig that may choose to dig it up. Nay, pigs have been known almost to choke themselves with it. Such a custom is disgusting, and should be put an end to. Let the substance be buried in a compost heap, and if there is none such on the farm, let it rather be buried in the earth, than exposed to be used in that manner. The umbilical cord or *navel string* breaks in the act of parturition.

(1092.) Should the cow seem *exhausted* by the protracted state of calving, she may be supported with a warm drink of gruel, containing a bottle of sound ale; and should she be too sick or indifferent to drink it herself, it should be administered to her with the drinking-horn (1633.). After the byre has been cleansed of the impurities of calving, and a supply of fresh litter introduced, the cow, naturally feeling a strong thirst upon her from the exertion, should receive a warm drink. I don't know a better one than warm water, with a few handfuls of oatmeal stirred in it, and seasoned with a handful of salt, and this she will drink up greedily; but a pailful is enough at a time, and it may be renewed in a short time after, should she express a desire for it. This drink should be given her for two or three days after calving, in lieu of cold water, and mashes of boiled barley and gruel should be made for her, in lieu of cold turnips; but the oil-cake should not be forgotten, as it acts at this critical period as an excellent emollient. A very common practice is to give a cow barley in the sheaf to eat, and even raw barley, when there is no barley in the straw, and sometimes a few sheaves are kept for the express purpose; and barley-chaff is given where people grudge to part with good barley. Though so very common, the practice is a very objectionable one, for nothing could be proposed that would cause indigestion so readily as raw barley or barley-straw at the time of calving, when the tone of the stomach is impaired by excitement, and it may be by fever. *Boiled* barley, or any other mucilaginous drink, is quite safe; but a substance that can hardly fail to irritate and inflame the stomach, is most injudiciously applied in the circumstances. In fact, nothing should be given to a cow at this time of an astringent nature, but rather every thing of a laxative quality.

(2093.) It is desirable to milk the new-calved cow as soon as convenient for her, as, whether the labour has been difficult or easy, the withdrawal of milk affords relief. It not unfrequently happens that an uneasiness is felt in the udder before calving, and should it increase while the symptoms of calving are long delayed, the cow may experience considerable inconvenience, especially if the flush of milk has been sudden.

The causes of uneasiness are an unequal hardness in the udder, and there is a heat, floridness, and tenderness all over it. Fomentation with warm water twice or thrice a day, continued for half an hour at a time, followed by gentle rubbing with a soft hand, and anointing with goose-grease, will tend to allay irritation. In the case of heifers with the first calf, the uneasiness is sometimes so great during the protracted symptoms of calving, as to warrant the withdrawal of milk before calving. Should the above remedial measures fail to give relief, the great heat in the udder may cause direct inflammation, and consequent suppuration. To avert such an issue, the uneasiness should not be neglected from the first moment it is observed, as neglect may allow the complaint to proceed so far as to injure the structure of a portion, if not the whole, of the udder.

(2094.) *Milking* is performed in two ways, stripping and nievling. *Stripping* consists of seizing the teat firmly near the root between the face of the thumb and the side of the fore finger, the length of the teat passing through the other fingers, and in milking, the hand passes down the entire length of the teat, causing the milk to flow out of its point in a forcible stream. The action is renewed by again quickly elevating the hand to the root of the teat. Both hands are employed at the operation, each having hold of a different teat, and moved alternately. The two nearest teats are first milked, and then the two farthest. *Nievling*, or handling, is done by grasping the teat round at its root with the fore finger like a hoop, assisted by the thumb, which lies horizontally over the fore finger, the rest of the teat being also seized by the other fingers. Milk is drawn by pressing upon the entire length of the teat in alternate jerks with the entire palm of the hand. Both hands being thus employed, are made to press alternately, but so quickly following each other, that the alternate streams of milk sounds to the ear like one forcibly continued stream. This continued stream is also produced by stripping. Stripping, then, is performed by pressing and passing certain fingers along the teat; nievling by the whole hand doubled, or *fist*, pressing the teat steadily at one place. Hence the origin of both names.

(2095.) Of the two modes, I prefer the *nievling*, because it appears to me to be the more natural method, inasmuch as it imitates the sucking of a calf. When a calf takes a teat into its mouth, it makes the tongue and palate, by which it seizes it, play upon the teat by alternate pressures or pulsations, while retaining the teat in the same position. It is thus obvious that nievling is somewhat like sucking, whereas stripping is not at all like it. It is said that stripping is good for agitating the udder, the agitation of which is conducive to the withdrawal of a large quan-

tity of milk; but there is nothing to prevent the dairy-maid agitating the udder as much as she pleases, while holding the teats in nievling. Indeed a more constant agitation could be kept up in that way by the vibrations of the arms than by stripping. Stripping, by using an unconstrained pressure upon two sides of the teat, is much more apt to press it unequally, than by grasping the whole teat in the palm of the hand; while the *friction* occasioned by passing the finger and thumb firmly over the outside of the teat, is more likely to excite heat and irritation in it than a steady and full grasp by the entire hand. To shew that this friction causes an unpleasant feeling even to the dairy-maid, she is obliged to lubricate the teat frequently with milk, and to wet it at first with water; whereas nievling requires no such expedients. And as a further proof that stripping is a mode of milking which may give pain to the cow, it cannot be employed, when the teats are chapped, or when these and the udder are affected with the cow-pox, with so much ease to the cow, as nievling. This difference I saw strikingly exemplified one summer, when all my cows were affected with the cow-pox, and when the assistant, who could only milk by stripping, was obliged to relinquish her duty till the cows were so far recovered as to be again able to endure her mode of milking.

(2096.) Milking should be done *fast*, to draw away the milk as quickly as possible, and it should be continued as long as there is a drop of milk to bring away. This is an issue which the dairy-maid cannot too particularly attend to herself, or see it attended to by those who assist her. Old milk left in the receptacle of the teat soon changes into a curdy state, and the caseous matter not being at once removed by the next milking, is apt to irritate the lining membrane of the teat during the operation, especially when the teat is forcibly rubbed down between the finger and thumb in stripping. The consequence of this repeated irritation is the thickening of the lining membrane, which at length becomes so hardened as to close up the small orifice at the point of the teat. The hardened membrane may easily be felt from the outside of the teat, when the teat is said to be *corded*. After this the teat becomes *deaf*, and no more milk can afterwards be drawn from the quarter of the udder to which the corded teat is attached.

(2097.) The *milking-pail* is of various forms and of various materials. The Dutch have brass ones, which are brilliantly scoured every time they are in use. Tin pitchers are used in some parts, whilst pails of wood in cooper-work are employed in other parts of the country. A pail of oak having thin staves bound together with bright iron hoops, with a handle formed by a stave projecting upwards, is convenient for milking

in, and may be kept clean and sweet. One 9 inches in diameter at the bottom, 11 inches at the top, and 10 inches deep, with an upright handle or lug of 5 inches, has a capacious enough mouth to receive the milk as it descends; and a sufficient height, when standing on the edge of its bottom on the ground, to allow the dairy-maid to grasp it firmly with her knees while sitting on a small three-legged stool. Of course, the pail cannot be milked full; but it should be as large as to contain all the milk that a single cow can give at a milking; because it is undesirable to rise from a cow before the milking is finished, or to exchange one dish for another while the milking is unfinished.

(2098.) The cow being a sensitive and capricious creature, is so easily offended, that if the dairy-maid rise from her before the milk is all withdrawn, the chances are she will not again stand quietly at that milking; or if the vessel used in milking is taken away and another substituted in its place, before the milking is finished, the probability is that she will *hold* her milk, that is, not allow it to flow. This is a curious property which cows possess of *holding up* or *keeping back* their milk. How it is effected has, I believe, never been ascertained; but there is no doubt of the fact, that when a cow becomes irritated, or frightened by any cause, she can withhold her milk. Of course, all cows are not affected in the same degree; but as a proof how sensitive cows generally are, I believe that very few will be milked so freely by a stranger the first time as by one with whom they have been accustomed.

(2099.) There is one side of a cow which is usually called the *milking side*—that is, the cow's left side—because, somehow, custom has established the practice of milking her from that side. It may have been adopted for two reasons; one, because we are accustomed to approach all the larger domesticated animals by what we call the *near side*—that is, the animal's left side—as being the most convenient one for ourselves; and the other reason may have been, that, as most people are right-handed, and the common use of the right hand has made it the stronger, it is most conveniently employed in milking the hinder teats of the cow, which are often most difficult to reach, because of the position of the hind legs, of the length of the hinder teats, or of the breadth of the hinder part of the udder. The near side is most commonly used in Scotland, but in many parts of England the other side is preferred. Whichever side is selected, that should always be used, as cows are very sensitive to changes.

(2100.) It is a rare sight to see a cow milked in Scotland by any other person than a woman, though men are very commonly employed at it in England. For my part, I never see a man milking a cow without be-

ing impressed with the idea that he is usurping an office which does not befit him; and this sense seems to be expressed in the terms usually applied to the persons connected with cows,—a dairy-*maid* implying one who milks cows, as well as performing the other functions of the dairy, —a dairy-*man* meaning one who owns a dairy.

(2101.) Cows are easily rendered troublesome on being milked; and the kicks and knocks which they usually receive for their restlessness, only render them the more fretful. If they cannot be overcome by kindness, thumps will never make them better. But the fact is, restless habits are continued in them by the treatment which they receive when first taken into the byre, when, most probably, they have been dragooned into submission. Their teats are tender at first; but an unfeeling horny hand tugs at them in *stripping*, as if they had been accustomed to the operation for years. Can the creature be otherwise than uneasy? and how can she escape the wincing but by flinging out her heels? Then hopples are placed on the hind fetlocks, to keep her heels down. The tail must then be held by some one while the milking is going on; or the hair of its tuft be converted into a double cord, to tie the tail to the creature's leg. Add to this the many threats and scolds uttered by the dairy-maid, and you will get not a very exaggerated idea of how a young heifer is broke into a byre. Some cows, no doubt, are very unaccommodating and provoking; but, nevertheless, nothing but a rational course of conduct towards them, administered with gentleness, will ever render them less so. There are cows which are troublesome to milk for a few times after calving, that become quite quiet for the remainder of the season; others will kick pertinaciously at the first milking. In this last case, the safest plan, instead of hoppling, which only irritates, is for the dairy-maid to thrust her head against the flank of the cow, and while standing on her feet, stretch her hands forward, and get a hold of the teats the best way she can, and send the milk on the ground; and in this position, it is out of the power of the cow to hurt her. These ebullitions of feeling at the first milking after calving, arise either from feeling pain in a tender state of the teat, most probably from inflammation in the lining membrane of the receptacle; or they may arise from titillation of the skin of the udder and teat, which become the more sensible to the affection, from a heat which is wearing off. Be the cause of irritation what it may, one thing is certain, that gentle discipline will overcome the most turbulent temper.

(2102.) Cows, independently of their power to retain their milk in the udder, afford different degrees of pleasure in milking them, even in the quietest mood. Some yield their milk with a copious flow, with the

gentlest handling that can be given; others require great exertion to draw the milk from them in streams no larger than threads. The udder of the former will be found to have a soft skin, and the teats short; that of the latter will have a thick skin, with long tough teats. The one feels like velvet, the other no better than untanned leather.

(2013.) The heifers that are to be transferred to the cow-stock should be taken from the hammels N, fig. 3, Plate III, in which they have been confined all winter, into the byre, about three weeks or a fortnight before their reckoning, at once into the stalls they are to occupy. If they had been accustomed to be tied by the neck when calves, they will not feel much reluctance in going into a stall; but if not, they require some coaxing to do it. When taking them to the byre, it should be remembered, that a fright received at this time may not be forgotten for a long time to come. To avoid every chance of that, let them go in quietly of their own accord; let them smell and look at every thing they wish; and let them become acquainted with them before driving them on; and having plenty of assistants to prevent any attempt to break away, let the cattle-man, with the shepherd, allow them to move on bit by bit, until they arrive at the stall. Here will be some difficulty; but a little favourite food in the manger will entice them to go up, especially if the time is chosen, which it should be, when they are hungry. Another difficulty will be experienced in putting the seal, fig. 11, round the neck. It should hang, when not in use, on a nail upon the stake; and on quietly taking it down, without clanking the chain, and while the creature is eating, let the cattle-man slip one hand below the neck, while the other supports the seal over it, and then bring the loose end of the seal round the neck, and hook it into whatever link he can first get. The moment the heifer feels it on her neck, she will hang back, or attempt to turn round in the stall to get away, which she should be prevented doing; and after remaining in that state for some time, and feeling herself gently used and kindly spoken to, she will yield; but although she may appear to submit, she must not be left alone for some time—not till there is an assurance that she will not attempt to turn in the stall. No dogs should be allowed to be near on this occasion. I have detailed thus minutely the first treatment of a heifer in a byre, that you may avoid an accident that happened to a fine short-horn heifer of mine, which, on being *rather rashly* prevented running away, was so quickly turned on the causeway, that a large callous lump grew upon the front part of her shoulder, and remained there unsubdued.

(2104.) The milk that first comes from the cow after calving is of a thick consistence and yellow colour, and is called *biestings*. It has the

same coagulable properties as the yolk and white of an egg beat up. After three or four days the biestings is followed by the milk. That which comes last, the *afterings* or *strippings*, as it is commonly called, is much the richer part of new milk, being not unlike cream. Being naturally thick, it is the more necessary to have it drawn clean away from the udder.

(2105.) The *structure of a cow's udder* is remarkable. It consists of 4 glands, disconnected with each other, but all contained within one bag or cellular membrane; and the glands are uniform in structure. Each gland consists of 3 parts, the *glandular* or secreting part, the *tubular* or conducting part, and the *teat* or receptacle or receiving part. The glandular forms by far the largest portion of the udder. It appears to the naked eye composed of a mass of yellowish grains, but under the microscope these grains are found to consist entirely of minute bloodvessels forming a compact plexus. These vessels secrete the milk from the blood. "Thus, then," says a writer, "we perceive that the milk is abstracted from the blood in the glandular part of the udder; the tubes receive and deposite it in the reservoir or receptacle; and the sphincter* at the end of the teat retains it there till it is wanted for use. But we must not be understood to mean, that all the milk drawn from the udder at one milking, or *meal*, as it is termed, is contained in the receptacle. The milk, as it is secreted, is conveyed to the receptacle, and when this is full, the larger tubes begin to be filled, and next the smaller ones, until the whole become gorged. When this takes place, the secretion of the milk ceases, and absorption of the thinner or more watery part commences. Now, as this absorption takes place more readily in the smaller or more distant tubes, we invariably find, that the milk from these, which comes the last into the receptacle, is much thicker and richer than what was first drawn off. This milk has been significantly styled *afterings;* and should this gorged state of the tubes be permitted to continue beyond a certain time, serious mischief will sometimes occur; the milk becomes too thick to flow through the tubes, and soon produces, first irritation, then inflammation, and lastly suppuration, and the function of the gland is materially impaired or altogether destroyed. Hence the great importance of emptying these smaller tubes regularly and thoroughly, not merely to prevent the occurrence of disease, but actually to increase the quantity of milk; for so long as the smaller tubes are

* The teat does not terminate in a true sphincter, there being no muscle in connection with it. A sphincter acts by the power of four muscles, which are contracted or expanded at will, and close or open the orifice around which they are placed.

kept free, milk is constantly forming; but whenever, as we have already mentioned, they become gorged, the secretion of milk ceases until they are emptied. The cow herself has no power over the sphincter at the end of the teat, so as to open it and relieve the overcharged udder; neither has she any power of retaining the milk collected in the reservoirs when the spasm of the sphincter is overcome." *

(2106.) You thus see the necessity of drawing away the last drop of milk at every milking, and the better milker the cow is, this is the more necessary. You also see the impropriety of *hefting* or holding the milk in cows until the udder is distended much beyond its ordinary size, for the sake of shewing its utmost capacity for holding milk, a device which all cow-dealers, and indeed every one who has a cow for sale in a market, scrupulously uses. It is remarkable that so hackneyed a practice should decieve any one into its being a measure of the milking power of the cow, for every farmer is surely aware, or ought to be aware, that the person who purchases a hefted cow on account of the magnitude of its udder exhibited in the market, gains nothing by the device; because, when the cow comes into his possession, she will never be hefted, and, of course, never shew the greatest magnitude of udder, and never, of course, confer the benefit for which she was bought in preference to others with udders in a more natural state. If, then, purchasers derive no benefit from hefting, because they do not allow hefting, why do they encourage so cruel and afterwards injurious practice in dealers? Would it not be better to select cows by udders in the state in which it is desired by purchasers they should be in their own possession? Were purchasers to set their face against the barbarous practice, the dealers would soon be obliged to relinquish it.

(2107.) Having spoken of the internal structure of the udder, its external form requires attention, because it indicates different properties. Its form should be spheroidal, large, giving an idea of capaciousness; the bag should have a soft fine skin, and the hind part upwards towards the tail be loose and elastic. There should be fine long hairs scattered plentifully over the surface, to keep it warm. The teats should not seem to be contracted or funnel-shaped at the onset with the bag. In the former state, teats are very apt to become corded or *spindled*, as another phrase expresses it, and in the latter too much milk will constantly be pressing on the lower tubes or receptacle. They should drop naturally from the lower parts of the bag, being neither too short, small, or dumpy, or long, flabby and thick, but perhaps about 3 inches in length,

* Blurton's Practical Essay on Milking, p. 6-7.

and as thick as just to fill the hand. They should hang as if all the quarters of the udder were equal in size, the front quarters projecting a little forward, and the hind ones a little more dependent. Each quarter should contain about equal quantities of milk, though I have always believed that the hind contain rather the most.

(2108.) Largely developed *milk veins*, as the subcutaneous veins along the under part of the abdomen are commonly called, are regarded as a source of milk. This is a popular error, for the milk-vein has no connection with the udder; but "although the subcutaneous or milk-vein has nothing to do with the udder," says Mr Youatt, "but conveys the blood from the fore part of the chest and sides to the inguinal vein, yet a large milk-vein certainly indicates a strongly developed vascular system—one favourable to secretion generally, and to that of the milk among the rest."*

(2109.) Let us now attend to the young calf. The navel-string should be examined that no blood be dropping from it, and that it is not in too raw a state. Inattention to this inspection may overlook the cause of the navel-ill, the treatment of which is given below; and insignificant as this complaint is usually regarded, it carries off more calves than most breeders are aware of.

(2110.) The first food which the calf receives consists of what its mother first yields after calving, namely, biestings. Being of the consistence of egg, it seems to be an appropriate food for the fœtus just ushered into the world. On giving the calf its first feed by the hand, in a crib in R, fig. 3, Plate III., it may be found to have gained its feet, or it may be content to lie still. In whichever position it is found, let it remain so, and let the dairymaid take a little biesting in a small dish—a *handy* formed like a miniature milk-pail, and of similar materials, will be found a convenient one—and let her put her left arm round the neck of the calf, and support its lower jaw with the palm of the hand, keeping its mouth a little elevated, and open, by introducing the thumb of the same hand into the side of its mouth. Then let her fill the hollow of her right hand with biestings, and pour it into the calf's mouth, introducing a finger or two into it for the calf to suck, when it will drink the liquid. Thus let her supply the calf, in handful after handful, as much as it is inclined to take. When it refuses to take more, the creature should be cleaned of the biesting that may have flown over. Sometimes, on a calf being begun to be fed, when lying, attempts to get upon its feet, and, if able, let it do so, and rather assist

* Youatt on Cattle, p. 244.

it up than prevent it. Some people are afraid to give a calf as much biestings at first as it can take, because it is said to produce the navel-ill. This is nonsense; let the creature take as much as it pleases, for biestings never harmed a calf, and certainly never produced navel-ill, though it has been accused of it; but if the truth were investigated, the illness would be found to have proceeded from neglect of proper inspection in due time, arising from ignorance of the danger. I have minutely detailed the primary and simple process of feeding a new dropped calf by hand, because very absurd ways are adopted in doing it. Nothing is more common than to plunge the calf's head into a large quantity of biestings, and because the liquid bubbles around its mouth with the breath of the nose, and it will not attempt to drink it, its head is the more forcibly thrust and kept down into the tub. How can it drink with its nose immersed amongst the fluid? and why should a calf be expected at first to *drink with its head down*, when its natural instinct should lead it to *suck with its head up?* It should always be borne in mind, that feeding calves by the hand is an *unnatural* process; nevertheless, it is a convenient, practicable, and easy one, provided it is conducted in a proper manner. The creature must be *taught to drink*, and a good mode of teaching it I have described above. In this way it is fed as often as the cow is milked, which is three times a-day. After the first two or three days, however, another plan should be adopted, for it should not be *accustomed* to suck the fingers, as then it will not drink without their assistance. The suceeding plan is to put a finger or two of the right hand into its mouth, and holding the small pail of milk with the left under its head, bring the head gradually down into the pail, where the fingers induce it to take a few gluts of the milk; but in doing this, the fingers should be gently withdrawn while the head is kept down in its position with the hand, taking care to keep the nostrils above the milk. In a few days more the fingers will not be required, and in a few days more still you will see the calf *drink* of its own accord.

(2111.) For the first month the calf usually has as much sweet milk warm from the cow as it can drink. It will be able to drink about 3 quarts at each meal, and in three meals a day, in the morning, noon, and evening, it will consume 8 quarts. After the first month it gets its quantity of milk at only 2 meals, morning and evening. It is supported 3 months in all on milk, during which time it should have as much sweet-milk as it can drink. Such feeding will be considered expensive, and no doubt it is, but there is no other way of bringing up a *good* calf. Some people grudge sweet-milk after a few days, and take the cream off it, and give the skimmed to the calves. This is considered thrifty management; but

its result does not ensure immediate gain, because it is not possible to extract double advantage from a given quantity of sweet-milk. If butter is preferred to calves, or good beasts at an after period, the wish is attained, and the farmer has had his preference; but he must know—at least ought to know—that he cannot obtain butter and good beasts from the same milk. Others, more generous, give half-sweet and half-skimmed milk to their calves; whilst some provide a substitute for a part of the milk, by making gelatine of boiled linseed or sago, and give it with no milk. When milk is actually scarce, such expedients are permissible; but when it is plentiful, and is used for other purposes than merely to serve the farm-house, the adoption of expedients is a practical avowal that the farmer does not wish to bring up his stock as he might do.

(2112.) The jelly from linseed, or *lythax*, as it is called, is easily made by boiling good linseed in water, and while it is in a hot state to pour it in a vessel to cool, when it becomes a firm jelly, a proportion of which is taken every meal, and bruised down in a tubful of warm milk, and distributed to the calves. They are very fond of it, and in the third month of the calf's age, when it can drink a large quantity of liquid at a time, and during a day, it is an excellent food for them. Sago may be prepared in the same way. But a better substance for calves than either, is, in my opinion, pea-meal. It should not be boiled, but made into *brose*, by pouring hot water upon it, and stirring the mixture till it is *fine*. It becomes gelatinous on cooling; and when cold, a portion of it is put into new warm milk, and mixed so intimately with the hand, that not a lump of the meal can be felt; and the mixture is made of a consistence which a calf can easily drink.

(2113.) Another mode of bringing up calves by breeders of stock, is to allow them to suck their mothers, and the plan is arranged in this way. Either a large crib is erected at a convenient part or parts of the cow's byre, to contain a number of calves each, in a loose state; and when the hours arrive at which they are fed, they are let out of the cribs from whence they each proceed forthwith to the cow that supports it. Or the calves are tied by the neck in stalls erected for the purpose against the wall of the byre, immediately behind the cows; and when the hours of the respective meals arrive, they are loosened from the tyings, and pass across the byre to the cows. Generally, in both cases, one cow suckles two calves; and a cow that has calved early may suckle two sets, or four calves, or at least three, in the season.

(2114.) With regard to the merits of this plan, I must remark that I am averse to tying calves by the neck. It cramps their motions, and deprives them of that freedom of action which is so conducive to health.

By preventing motion they will no doubt sooner acquire condition; but for stock-calves, kept for the formation of a herd, this is of less importance than strength acquired by moderate exercise within a limited size of crib. As to having a number of calves within the same crib, though they all have liberty of motion, they are so commixed as to have liberty to suck at one another. The ears, navel, scrotum, and teats, suffer by this dirty habit; and there is no preventing it after it has been acquired, so long as two remain together. Upon the whole, therefore, I much prefer the separate crib to each calf, so formed of spars as to allow every calf to see its neighbours, and so sensibly in company, as to remove the idea of loneliness. The separation prevents the abominable habit of sucking being acquired; and the crib is as large and no larger than to allow them to move about for exercise, without fatigue.

(2115.) In regard to *suckling calves*, there is no question it is the best way of bringing them up, provided the calf has free access to its mother or the cow which is supporting it; but I am doubtful of the superiority of suckling over feeding by hand, in the case where the calf is only allowed to go to the cow at stated times. It saves the trouble of milking the cows and giving milk to the calves; but the saving of trouble is not so important a consideration in the rearing of young stock as the promotion of their welfare. There is one objection to suckling where one cow brings up two calves, that the quantity of milk afforded to each is unknown; and the stronger or more cunning calf may steal the larger share. True, they are both brought up; but are they brought up as well as they might be, with the assistance of nourishing food, when the milk becomes scarcer, which it will be to each calf the older it grows? Another objection to suckling is, that a cow which suckles calves at one period of the season does not take kindly afterwards to milking with the hand; and a cow will always prefer to be sucked to being milked by the hand. Unless, therefore, cows are kept for the purpose of suckling, they become troublesome to milk after the calves are weaned.

(2116.) At a month old the male calves that are not intended to be kept for bulls are *castrated*. Though the operation is very simple and safe, yet it should not be performed at a time when there is any affection of the navel string, or indication of costiveness or dysentery; these exciting causes of the system should first be removed ere another is voluntarily superadded. Supposing the calf is in good health, the castration is performed in this manner. An assistant places the calf upon its rump on the litter, and, sitting down himself, takes it between his outstretched limbs on the ground, with its back against his breast. Then

seizing a hind-hock of the calf in each hand, he draws a hind leg up to each side of its body, and holds both in that position as firmly as he can. The operator makes the testicles keep the scrotum smooth and stretched with his left hand, and then cuts with a sharp knife through all the integuments till he reaches one testicle, which he seizes, pulls out as much of the spermatic cord as he can, and there divides it. The same operation is performed on the other testicle, and the castration is finished in a minute or two. The calf feels stiff in the hind quarter for a few days, and the scrotum may swell; and if the swelling appear to become serious, fomentations of warm water should be frequently applied; and should suppuration ensue, the incisions made in the scrotum should be opened to give it vent; but the probability is, that the cut will heal by the first intention, and give no further uneasiness to the calf than a feeling of stiffness in the hind quarter for a few days.

(2117.) The practice was, some time ago, to *spay* the heifer calves, that is, to make an incision in the flank, and destroy the ovaries of the womb, by which all desire for the bull is extinguished; but the operation is falling into desuetude, not on account of the failure of its object, but probably from the circumstance of every breed of cattle being so much improved within the last thirty years, that the heifers are now generally considered to be fit for breeding, and are therefore kept *open*, as the phrase is, to be disposed of at a better price for breeding, than for bearing fat.

(2118.) When the air becomes mild as the season advances, and when the older calves attain the age of two months, they should be taken out of the cribs and put into the court *k*, fig. 3, Plate III, during the day; and after a few days' endurance to the air, should be sheltered under the shed in the court at night, instead of being again put into the cribs. Some sweet hay should be offered them every day; as also, a few sheep-slices of Swedish turnips to munch at. Such a change of food may have some effect on the constitution of the calves, causing costiveness in some and looseness in others; but no harm will arise from these symptoms, if remedial measures are employed in time. Large lumps of chalk to lick at will be found serviceable in looseness. The shed of the court should be fitted up with small racks and mangers to contain the hay and turnips, and chalk. Should a very wet, snowy, stormy, or cold day appear after the calves have been put into the court, they should be brought back to their cribs till the storm pass away.

(2119.) At 3 or 4 months old, according to the supply of milk and the ready state of the grass to receive them, the calves should be *weaned*

in the order of seniority, due regard being at the same time had to their constitutional strength. If a calf has been always strong and healthy, it may be the sooner weaned from milk if there is grass to support it; but should it have ailed, or be naturally puny, it should be remembered that good sweet milk is the best remedy that can be administered to promote condition or recruit debility, and should be given with an unsparing but judicious hand. Calves, on being weaned, should not be deprived of milk at once; it should be lessened in quantity daily, and given at longer intervals by degrees, so as they may not be sensible of their loss when it is entirely withheld. I have frequently observed, that when calves are stinted of milk preparatory to weaning, means of supplying them with a sufficient quantity of food of an enticing nature are not so well attended to as they ought. Fresh bundles of the most clovery portions of the hay, turnips fresh sliced, pure fresh water at will, a little pounded oil-cake, if presented at times when they used to get their milk, will induce them to eat those substitutes with contentment; whereas, when these are entirely neglected, or the trouble grudged in supplying them, and the creatures are left to pick up what they can for themselves in a court or bare lea, they cannot but suffer from hunger, and vociferate for the loss of what they had enjoyed till then. Thus treated, they inevitably fall off in condition; and which, if they do at the critical period of weaning, the greater portion of the ensuing summer will elapse ere they regain their former condition, strength, and sleekness of coat. A small paddock near the steading is an excellent place for weaning calves, before turning them out to a pasture field; but then it should afford a full bite of grass to support them as the milk is taken from them, otherwise they will be more injured than benefited in it.

(2120.) When *bull* calves are brought up, they should be early calved, and receive as much new milk as they can consume; and they should not be weaned till the grass is fully ready to support them. The object of this high keeping is not to fatten them, but to give strength to their *bones*, and vigour to their *constitution*, these being much strengthened by the quality and quantity of food given to calves at the earliest period of their existence. The valuable impulse thus given in calfhood to these very essential properties in bulls is evinced in the vigour of succeeding life, and it is sure to lay a foundation upon which a durable superstructure may be raised, and, what is more, no *durable* structure can be raised on any other. Even in ordinary cases, push a calf forward in the first month of its existence, and the probability will be that it will evade every disease incident to its age.

(2121.) In concluding my observations on the treatment of calves at

this time, I may mention, that when they receive their milk in the court, some which have either had their portion already, or are about to get it, are apt to plague those which are getting theirs, by poking their heads into the same pail, or by boxing them, or by sucking their ears, &c. To prevent such annoyances, and to indicate that discipline is to be observed, the dairy-maid should be provided with a supple cane or switch, and apply it in gentle strokes to the ears of every one disposed to be troublesome, whether their interference consists of annoyance at the pail or in sucking. This gentle discipline can do no harm to those which are subjected to it, while it impresses them with the necessity of obedience. We err if we consider animals, because they are dumb and young, incapable of tuition of any kind. They are susceptible of it, and the sense of its power is evinced by obedience.

(2122.) The following table, containing the dates at which cows should calve from those at which they are bulled, will be found useful to you for reference. It is unnecessary to fill up the table with marking down every day of the year, as in the short period between each fortnight you can easily calculate the particular reckoning of each cow. The period of gestation is taken at 273 days, or 9 calendar months, which is the minimum time, and from which the symptoms of calving should be narrowly watched, till the event of calving actually takes place.

A Reckoning-Table for the Calving of Cows.

When Bulled.		When will Calve.		When Bulled.		When will Calve.	
January	1.	October	1.	July	16.	April	15.
...	15.	...	15.	...	30.	...	29.
...	29.	...	29.	August	13.	May	13.
February	12.	November	12.	...	27.	...	27.
...	26.	...	26.	September	10.	June	10.
March	12.	December	10.	...	24.	...	24.
...	26.	...	24.	October	8.	July	7.
April	9.	January	7.	...	22.	...	21.
...	23.	...	21.	November	5.	August	4.
May	7.	February	4.	...	19.	...	18.
...	21.	...	18.	December	3.	September	1.
June	4.	March	4.	...	17.	...	15.
...	18.	...	18.	...	31.	...	29.
July	2.	April	1.				

(2123.) The usual modes of determining whether a cow is in calf are deceptive; she may not hold when bulled; she may take the bull again in a few days; and she may not shew evident symptoms of calving but for a few days only before she actually calves. The most certain sign of pregnancy is the en-

largement of the abdomen, and filling of the flanks, in the third or fourth month. A more philosophical method of determining whether a cow is in calf at all, has been discovered by medical men, by the application of the ear to the flank of the cow, suggested by the curious and valuable discoveries brought to light by the *stethoscope*. "That greatest of improvements in veterinary practice," observes Mr Youatt, "the application of the ear to the chest and belly of various animals (in order to detect, by the different sounds—which, after a short time, will be easily recognised—the state of the circulation through most of the internal organs, and consequently the precise seat and degree of inflammation and danger), has now enabled the breeder to ascertain the *existence of pregnancy* at as early a stage of it as *six or eight weeks*. The beating of the heart of the calf will be distinctly heard, twice, or more than twice, as frequent as that of the mother; and each pulsation will betray the singular double beating of the fœtal heart. This will also be accompanied by the audible rushing of the blood through the vessels of the placenta. The ear should be applied to the right flank, beginning on the superior part of it, and gradually shifted downwards and backwards. These sounds will soon be heard, and cannot be mistaken."*

(2124.) A few years ago a plan of drawing milk from the cow was recommended by Mr Blurton, Field Hall, Staffordshire, by introducing a tube into the teat, and milking other teats at the same time. He was once of opinion that a tube in each teat would draw away all the available milk at the time from the udder; but finding his mistake in this, he has adopted the following method of milking. I may mention that he names his tubes *siphons*, but they have not the form, and therefore cannot have the property, of the siphon, which first elevates the fluid in a vessel in order to draw it over its rim, whereas his tubes just allow the milk to run out of the bottom of the udder through the opened teat. His improved plan of milking is this:—"The milker sits down as in the common method, fixing the siphon can (pail) firmly between his knees: he then takes hold of the near hand teat with a slight pressure of his right hand, and with his left introduces the *small* tube of the siphon an inch or more into the teat, putting the thumb on the large tube, to prevent the milk from running out till completely introduced; and so on with the near fore teat, reserving the two farthest teats to be milked by hand. By this method I find that I can milk three teats with my right hand, assisted by the siphons, in the time I can milk one with my left, and this with ease and comfort to myself. I must here also observe, that the action of milking one or two teats by hand, is quite sufficient to induce the cow to give her milk down freely from those milked by the siphons; as I have before observed, the cow does not possess the power of retaining her milk in any one quarter of the udder, while it flows freely from the others." These tubes, containing a small and larger end, beyond which they cannot pass into the teat, may be made of ivory, bone or metal. They should be thrown into the pail and milked on before being used, and when taken out of the teat let fall into the can. When in use they should be dipped in boiling water and blown through. They do not seem to possess any advantage over the hand; on the contrary, the hand must be employed to complete what they cannot accomplish, and must be in use when they are employed. Mr Blurton very properly advocates clean milking, and describes a very good plan by which, I have no doubt, will be drawn away

* Youatt on Cattle, p. 533.

all the milk from an udder much better than by any tube. " In aftering," he says, " I have adopted the plan of using the *left hand to press down the thick milk* into the receptacle and teat, at the same time *milking with the right hand ;* then in a similar manner discharging the whole from the remaining quarters of the udder." He adds what is very true, that " it must not be supposed that this method is distressing to the animal; on the contrary, her quietness during the process is a satisfactory indication that it occasions no pain, but rather an agreeable sensation." *

(2125.) On *carse farms* no calves are brought up, those produced by the cows which supply the people with milk being sold to rearers of stock or fattened for the butcher. On *pastoral farms*, devoted to sheep, the same plan is usually pursued; but on those which rear cattle only, as on the west coast of Scotland, in Wales, and in Ireland, the calves are suckled by the mothers and entirely brought up by them, which, as I have already said, is an excellent plan, provided the mothers are well fed, and make their calves follow them over the pastures, for then they will become strong, and kept free of disease. On *dairy farms* calves are not brought up, the milk being appropriated to quite other purposes, nevertheless, it is in the dairy districts that the calves are best fattened for the butcher.

(2126.) Strathaven in Scotland has long been famed for rearing good *veal* for the Glasgow and Edinburgh markets. There the dairy farmers retain their quey calves for maintaining the number and vigour of their cow stock, while they feed the male calves for veal. Their plan is simple and efficacious, and therefore may be followed any where. They give the calves milk only, and seldom any admixture, and they do not allow them to suck their dams. Some give milk, but sparingly at first, to whet their appetite, and all take care not to produce surfeit by giving too much at a time. The young calves get the first drawn milk, or *fore-broads*, as it is termed, and the older less of the fore-broads and more of the *afterings*, and frequently that of two or three cows, as being the richest portion of the milk. After they are three or four weeks old they get abundance of milk, but only twice a day. They get plenty of dry litter, fresh air, moderate warmth, and are kept nearly in the dark to check sportiveness. They are not bled during the time they are fed, and a lump of chalk is placed within their reach. They are fed from 4 to 6 weeks, when they fetch from L.3 to L.4 a-piece; and it is found more profitable to fatten a number of calves for that time, to succeed each other, than to force them beyond the state of marketable veal, of from 25 lb. to 30 lb. per quarter.†

(2127.) The plan followed of fattening calves, at a distance of from 10 to 30 miles around London, is very different. There, the cows are made to suckle the calves three times a-day for the first three or four days, and afterwards twice a-day. If the cow is full of milk, two calves are put to her; and, at any rate, one calf is put on after another is fattened off. In this way, the veal-farmers keep from 6 to 12 cows each, and convert their whole milk into veal. The calves are placed in boarded boxes, 4 feet high, and just large enough inside for a calf to turn. The floor is also boarded, the boards have holes, are raised from the ground, and littered with clean wheat-straw. A lump of chalk is placed within reach of each calf. The calf is fed for 10 weeks, when it will attain

* Blurton's Practical Essay on Milking, p. 10-12.

† Quarterly Journal of Agriculture, vol. v. p. 249.

about 35 lb. per quarter or more, and is then warranted *prime* veal. A calf, however, of 9 or 10 stones, will fetch a shilling or two a-stone more than one of 17 or 18 stones. Notwithstanding this, the English veal-farmers believe, contrary to those in Strathaven, that a calf grows and fattens faster after it is 10 weeks old than before, and requires less milk to improve it; and the profit is greater, inasmuch as one large calf incurs only one prime cost, one risk of life, and one commission; whereas, two small calves incur two cost prices, the risk of two lives, and two commissions. The butchers bleed the calves repeatedly before slaughtering them; and they judge of the colour of the flesh by looking at the inside of the mouth and white of the eyes. "The profit of fattening calves," observes Mr Main, "may be judged of by an example in figures, which I have oft experienced. A calf is suckled for 10 weeks, and weighs from 10 to 11 stones imperial, *sinking the offal*, as it is called in London. The calf fetches L.5 at market, from which deducting 30s., which it might have been sold for when a week old, and 5s. salesman's commission, leaves a profit of L.3, 5s., or 6s. 6d. per week for the cow's milk. Now, deducting 2s. 6d. per week for the keep of the cow, the bare profit left is only 4s. per week. But it must be remembered, that a good cow will fatten off two calves while she is in milk—some I have had, two and a half; but this can be but rarely accounted on. Still, taking one cow with another, kept for the purpose of suckling, her annual returns will be nearly what it is commonly estimated at, namely, L.12. To *ensure* this, or any other sum, as clear profit, depends entirely on the attention bestowed on the cows and calves. Some cows are odd-tempered, letting down their milk only to their own calves, and withholding it from those they are made to foster. This, if not corrected, will injure both cow and calf; the one will be starved, and the other will soon become dry." *

(2128.) Veal is generally considered a delicate species of meat; is held in high repute as a dish; and always fetches a higher price in the market than beef or mutton, being 9d. per lb. when beef is 6d. or 7d.; and, on this account, it is a remarkable fact, that fresh fried veal takes 4½ hours to digest. †

(2129.) *Diseases of Young Calves.*—While speaking of the calf, I may here notice the diseases to which it is subject at this period of its existence, and in this season of the year. The young calf should get quit of the black and glutinous fæces that had been accumulating in its intestines during the latter period of its fœtal existence; and there is no aperient better suited for the purpose than biestings. The farmer, therefore, who throws it away, does not know the jeopardy in which he places the lives of this branch of his young stock. Should there not be enough of biestings to remove the fæces, 2 or 3 oz. of castor oil, beat up with the yolk of an egg, or in thick gruel, should be administered, and a scruple of powdered ginger, to act as a carminative. In cases of costiveness, which young calves are very liable to contract, and inattention to which, at first, is the cause of the loss of many of the best young stock, arising partly from repletion of milk at times, when calves are permitted to suck their dams, or when they eat too much hay at one time after the milk has been too suddenly removed from them at weaning, active measures should be adopted to prevent its confirmation, for then the case becomes hopeless, as fever will inevitably ensue, and the food harden into a mass in the maniplies. Doses

* Quarterly Journal of Agriculture, vol. v. p. 611.

† Combe on Digestion and Dietetics, p. 136.

of warm water, containing a solution of 2 or 3 oz. of Epsom salts, should be frequently administered, both to dissolve the matter in the stomach, move the bowels, and wash out the stomach. Calves are liable to a disease of an opposite nature from this, namely, *looseness, scouring*, or *diarrhœa*. They are most subject to it when put out to grass, though still on milk, at too early an age. I should say that, if so treated before attaining 2 months, they are certain of being affected with it. One means of prevention is, to retain the calves in the house or shed till they are at least 2 months old, and if a little older so much the better. Of course, it is only the latest calves that are likely to be thus treated, the earlier having attained mature age for weaning before the grass is ready. In the house, scouring may be brought on by starvation and excess, and on grass by a sudden change of food. So long as the calf is lively and takes its milk, there need be no apprehension from a thin discharge of fæces; but dulness and loathing of food, accompanied by discharge, should create alarm. The first application of a remedy should be a mild purgative, to remove, if possible, the irritation of the bowels, and then should follow anodynes, astringents, and alkalies, with carminatives, the withdrawal of every sort of green food, and the administration of flour or pea-meal gruel. The following mixture the farmer is called to "*rely* on, and it is recommended that he should have it always by him, as it will do for all sucking animals, namely, 4 oz. of prepared chalk, 1 oz. of Winters' bark, powdered, 1 oz. of laudanum, and 1 pint of water. Give 2 or 3 table-spoonfuls, according to the size of the animal, 2 or 3 times a-day."* Another recipe is,—"Take from ½ oz. to ¾ oz. of tincture of rhubarb, with an equal quantity of water, according to the age and strength of the calf. To be given every alternate day in case one dose is not sufficient. I have used the remedy for several years," says a writer, "and have not lost a calf."† Mr E. E. Dawson, Ingethorpe, Grantham, recommends this,—"For young calves boil ½ oz. of ground black pepper in half a pint of ale; add a tea-spoonful of ginger; mix together; to be given lukewarm every morning until the calf recovers of its weakness; to have its milk as usual. Older calves will require ⅓ more for a complete cure. Great care should be used in making use of the above recipe, that the animal does not receive the mixture too fast; for want of attention mischief may be done."‡ I have given all these remedies for the scour in calves, for it would appear that it may be removed by various means, and one may be more efficacious in one locality than in any other. I never experienced among my calves but one instance of serious scouring. It was a short-horn quey-calf, and the recipe which effected a cure, after trying many, was very like the first, though I now forget the exact ingredients, with the exception of the pint of water, for which flour-gruel was substituted.

(2130.) *Calf-louse.*—It is not a little singular, in a physiological point of view, that there should be a *peculiar pedicular parasite appropriated to the calf*, yet such appears to be the case, although the creature is by no means common. It is very like the ox-louse, *Hæmatopinus eurysternus*, fig. 268, but comparatively narrower, and having two rows of dusky spots on the abdomen. It is termed *Hæmatopinus vituli*, or louse of the calf.§

* Johnson's Farmer's Encyclopædia, art. *Diarrhœa*.

† Bell's Weekly Messenger for March 1842.

‡ Mark Lane Express for November 1842.

§ Denny's Monographia Anoplurorum Britanniæ.

(2131.) Mr Youatt gives a description of castrating bull-calves in France by means of *torsion*, termed *bistournage*. The effect of the torsion seems to be, that the testicles remain fixed against the abdomen, and gradually wither away. The animal is usually bled after the operation, and half of its allowance of food is for a while taken away; and it may be sent to pasture on the second or third day if the weather is favourable. Although this mode of castration does not seem very painful to the animal, and is rarely attended by any dangerous results; yet when we are informed of the state in which it leaves the ox, that "the animals that are thus emasculated are said to preserve more of the form of the bull than others from whom the testicles are excised; they also retain more of the natural desires of the bull, and are occasionally very troublesome among the cows;" * it is not probable that the breeders of this country will desiderate to follow a practice which will let loose such a pest amongst their herds; for they are already too well aware of the plague of even a single *riglin* or *chaser* on a farm, to wish to convert all their barren cattle into a legion of tormentors.

(2132.) In ordinary cases of calving, little apprehension need be felt for the safety of the cow, and if her hind-quarter is raised up with a bedding of straw, the relaxed parts will soon recover their tone; but in cases of severe labour, the cow may be overtaken by several casualties, such as *flooding* or loss of blood; *inversion*, *relaxation*, and *inflammation of the womb*; *inflammation of the external parts*; and *puerperal* or *milk fever*. In the occurrence of any or all of these cases the assistance of a veterinary surgeon ought to be obtained at once, for improper treatment may not only induce a high state of excitement, or even fever, in the cow, but may injure the parts so much as to render her unfit to bear another calf. I never witnessed the occurrence of any of these complaints but the last, namely, the milk-fever, from which I am willing to believe they are rare, and shall therefore confine my observations to it.

(2133.) "Although parturition is a natural process," as well observed by Mr Youatt, "it is accompanied by a great deal of febrile excitement. The sudden transferring of powerful and accumulated action from one organ to another—from the womb to the udder—must cause a great deal of constitutional disturbance, as well as liability to local inflammation." † One consequence of this constitutional disturbance of the system is *milk-fever*. "The cause of this disease," says Skellett, "is whatever obstructs perspiration, and accumulates the blood internally; hence it may be produced by the application of cold air, by lying on the cold ground, or by giving cold water after calving; and these causes will naturally produce this effect from the open state of the pores at this time, and from the external parts being so wide and relaxed after the operation. Cows in high condition are more subject than others to this complaint, and especially if they have been kept up for some weeks before calving." ‡ The complaint may seize the cow only a few hours after calving, or it may be days. Its first attack is probably not observed by those who have the charge of the cows, or even by the farmer himself, who is rather chary in looking after the condition of his cows, in case of offending his female friends, to whose special

* Youatt on Cattle, p. 561.

† Ibid., p. 546.

‡ Skellett on the Parturition of the Cow, p. 195.

care that portion of his stock is consigned. The symptoms are first known by the cow shifting about in the stall, or from place to place if loose, lifting one leg and then another, being easily startled, and looking wildly about her as if she had lost her calf, and blaring for it. Then the flanks begin to heave, the mouth to open and issue clear water, she staggers in her walk, and at length loses the use of her limbs, and lays her head upon her side. The body then swells, the extremities feel cold and clammy. Shivering and cold sweats follow, the pulse becomes irregular, and death ensues. The promptest remedy to be used, after the first symptom has been observed, is to bleed to the extent of 3 or 4 quarts; and the next is to open the bowels, which will be found to have a tendency to constipation. From 1 lb. to 1½ lb. of Epsom salts, according to the strength of the cow, with a little ginger and carraway, should be given as a purge; and if the doze does not operate in due time, ½ lb. of Epsom salts should be given every 6 hours until the bowels are opened. This result will be much expedited by a glyster of warm thin gruel and soap or oil. After the opening medicine has operated, a cordial drink will be necessary, by which time the cow may shew symptoms of recovering in expressing an inclination to eat, with which she should be gratified, but with precaution.

(2134.) *Red-water.*—The ninth day after a cow has calved an uterine discharge should take place and continue for a day or two, after which the cow will exhibit all the symptoms of good health. I have observed that when this discharge does not take place that the cow will soon after shew symptoms of red-water. She will evacuate urine with difficulty, which will come away in small streams, and be highly tinged with blood, and at length appear like dark grounds of coffee. "The nature and cause of the disease are here evident enough," as Mr Youatt well observes. "During the period of pregnancy there had been considerable determination of blood to the womb. A degree of susceptibility, a tendency to inflammatory action had been set up, and this had been increased as the period of parturition approached, and was aggravated by the state and general fulness of blood to which she had incautiously been raised. The neighbouring organs necessarily participated in this, and the kidneys, to which so much blood is sent for the proper discharge of their function, either quickly shared in the inflammation of the womb, or first took an inflammation, and suffered most by means of it."* The prevention of this disease is recommended in purgative medicine after calving; but as such an administration, in the circumstance, never fails to affect the quantity of milk given by the cow for some time after, a better plan is to administer food which will operate as a laxative at the same time, for some time before as well as after calving, and the substance which possesses these two properties is *oil-cake.* I have proved this from experience. I lost two cows in Forfarshire by red-water, one a short-horn and the other an Angus, and one of the hinds lost one also; all in different but successive years. By examination of the stomach and bowels after death, I became satisfied that the determination of the blood to the womb, during pregnancy, had caused a tendency to inflammation in the bowels and stomach, and that indigestion and constipation were the consequences, and these were aggravated by the state of the food, which consisted entirely of Swedish turnips, which, at that season, in April, are fibrous and sweet, by the juice becoming concentrated in the bulb, and which the more readily induce cattle to eat them. The

* Youatt on Cattle, p. 504.

remedy was an obvious one, give laxative diet, and as that cannot readily be effected by turnips, particularly in cows which do not receive so many as they can eat, nor by raw potatoes, which incur the risk of hoven (1514.), and to the giving of potatoes to cows I have always had an utter aversion, call it prejudice, if you will; and as potatoes boiled have no laxative effects, the only alternative was oil-cake, and, fortunately, from the period I employed it medicinally to the cows, for a month before and a month after calving, to the extent only of 4 lb. a-day to each cow, and which quantity was also given to the hind's cows about the time of their calving, the complaint was never more seen or dreaded.

(2135.) I had never seen the disease in Berwickshire, and the opinion in Forfarshire, where the disease is prevalent, that it arises from cows eating some noxious plant, and is there called the *muir-ill*, as if it were the consequence of cows eating muirish plants, cannot be well founded; for cows that have never tasted the productions of muirs are attacked by it, and the *same sown* grasses cannot produce different effects in different parts of the country, as none of the sown grasses are noxious to cattle. Besides, a two-years' pasture has not time to become stocked with natural plants, whether noxious or innoxious; nor could the noxious effects of even natural pasture plants be felt in spring, after cattle have lived upon turnips for a number of months; nor can the administration of a simple laxative, for a few days in spring, counteract the effects of plants grazed on for half a year in the previous summer. Indigestion and constipation, at the time of calving, therefore, must arise from some other cause than the consumption of plants in summer. These may be superinduced by the prevailing practice in Forfarshire, and I believe to the northward of that, of keeping cows shut up in the byre during the whole winter half-year. Remove the tendency to constipation by the administration of a gentle laxative, and at the same time allow cows air and exercise in winter in a court, and under a shed when shelter is desirable, and the complaint will either never more be heard of or be comparatively rare in spring after calving. Whatever may be the cause of the disease in summer, in cases where cows, in certain places, have liberty to roam over marshes, muirs, or woods, and eat what plants hunger may impel them, it is clear that the same cause cannot affect a cow with the disease in the very different circumstances to which I have referred in spring.*

(2136.) I may here mention an unaccountable fatality which overtook a short-horn cow of mine, in Forfarshire, immediately after calving. She was an extraordinary milker, giving not less than 30 quarts a-day in summer on grass; but what was more extraordinary, for two calvings the milk never dried up, but continued to flow to the very day of calving, and after that event returned in a flush. In the third year she went naturally dry for about a month previous to the day of reckoning; every precaution, however, was taken that the milk should dry up without giving her any uneasiness. She calved in high health, the milk returned as usual in a great flush after calving, but it proved an impossibility to draw it from the udder; not a teat would pass the milk, *all the four being entirely corded*. Quills were introduced into them at first; and then tubes of larger size were pushed up to the root of each teat. A little milk ran out of one of them—hope revived; but it stopped running, and all the art that could

* See Prize Essays of the Highland and Agricultural Society, vol. ix. p. 8–34; for a number of essays on this subject, all of which, it will be observed, unconditionally ascribe the origin of the disease to cattle eating some noxious plants.

be devised by a skilful shepherd proved of no avail to draw milk from the udder; rubbing and softening the udder with goose-grease, making it warmer with warm water—all to no purpose. To render the case more distressing, there was not a veterinary surgeon in the district. At length, the udder inflamed, mortified, and the cow died in the most excruciating agony on the third day, from being in the highest state of health, though not in high condition; for her milking propensity usually kept her lean, but still she was always spirited. No loss of the kind ever affected my mind so much—to think that nothing *could* be done to relieve the distress of a creature that could not help itself. I was told afterwards by a shepherd to whom I related the case, that I should have cut off all the teats by the roots; which horrid operation would, of course, have destroyed her for a milch cow, but, he conceived, would have saved her for feeding. He had never *seen that* operation performed on a *cow;* but it suggested itself to him in consequence of having been obliged at times to cut off a ewe's teat or teats to save her life. The suggestion I think good; and I mention it that it may occur to you in similar circumstances. I purchased this cow when a quey in calf, along with another, from Mr Currie, then in Brandon, Northumberland.

(2137.) *Tail-ill, or Tail-slip.*—There is a very prevalent notion in Scotland amongst cattle-men, that when the tail of an ox or of a cow feels soft and supple immediately above the tuft of hair, there is disease in it; and it is called the tail-ill, or tail-slip. The almost invariable remedy is to make a large incision with the knife along the under side of the soft part, stuff the wound full of salt and butter, and sometimes tar, and roll it up with a bandage for a few days, and when the application is removed, the animal is declared quite recovered. Now, this notion is an absurdity. There is no such disease as imputed; and as the poor animal subjected to its cure is thus tormented, the sooner the absurd notion is abandoned the better. The notion will not soon be abandoned by the cattle-men; but the farmer ought to forbid the performance of such an operation on any of his cattle without his special permission; and the practice of the absurdity will fall into desuetude. "The disease, in ordinary cases," as Professor Dick describes it, "is *said* to consist in a softening of the bones about the extremity of the tail (*mollities ossium*); and is to be distinguished by the point of the tail being easily doubled back upon itself, and having, at this doubling, a soft and rather crepitating kind of feel. But let us inquire," as the Professor very properly suggests, "what is the *healthy* state of this organ, and what is its use, before we proceed to pronounce upon this supposed disease. Almost all the lower animals are furnished with this organ; in some adding much to their grace and symmetry, and in all being an organ of greater or less utility." Now, the natural structure of the tail is this: "The tail of the ox is lengthened out to the extent of 3 feet, and is formed like a common whip. Towards the extremity, the bones terminate gradually, becoming insensibly smaller as they approach to this termination. At this part is found a soft space, which is said to be the *seat* of this *disease*, the *tail-slip*. Beyond this, again, a firm, swelling, cartilaginous portion is found, covered with hair, to brush off the flies within its reach. Now, why have we the long column of bones, the termination with a soft space of a few inches, and this thickened hard cartilaginous part at the very extremity, and that extremity covered with hair? Why, but with a view to form a whip to drive off, with the greatest possible effect, the insects which wound and torment the animal. Here, the column of bones forms the elastic shaft or handle of the whip; the soft part, the connection between the

handle and thong, the couple ; while the thickened extremity may be easily recognised to represent the thong, and the hair to form the lash or point. They have thus a whip to drive and a brush to wipe off their foes as they make their attack." The tail being thus shewn to be admirably suited for its purpose, it could not be so well suited for it if it wanted the very soft part that is said to be so susceptible of disease. On the conclusion to be drawn from this statement of facts, the Professor anticipates it thus, "But it will perhaps be asked, after what I have stated of the facts previously ascertained, do I deny the existence of the *tail-slip?* I answer, Yes. But if I am again asked, Is the *tail not liable to disease?* I answer, it is ; but these diseases, or rather injuries, are only those common to other parts. The *softness* at the extremity is *no disease;* it is the natural structure, intended to allow a free and extensive motion ; and although, in some cases, mortification may have attacked the extremity of the tail, ought we not to ascribe this to some common cause—some external injury? or might it not perhaps become frost-bit by exposure to cold?"* A real disease of the tail, whatever it is, is, at all events, *not* the tail-ill.

(2138.) Cows differ very much in the time they continue to give milk, some not continuing to yield it more than 9 months, whilst others afford it for years. The usual time for cows that bear calves to give milk is 10 months. The cow that died in consequence of the corded teats, mentioned above (2136.), gave milk for 3 years, and bore a calf every year. A cow of mine that slipped her calf, and was not again served by the bull, gave milk for 19 months. But many remarkable instances of cows giving milk for a long time are on record. "The immense length of time for which some cows will continue to give milk," says a veterinary writer, "if favourably treated, is truly astonishing ; so much so as to appear absolutely incredible. My own observation on this subject extends to four most remarkable cases: 1. A cow purchased by a Mr Ball, who resided near Hampstead, that continued to give milk for 7 years, subsequently to having her first and only calf. 2. A large dun Suffolk cow, shewn to me as a curiosity by a Yorkshire farmer. This animal, when I saw her, had been giving milk for the preceding 5 years, during which period she had not any calf. The five-years' milking was the result of her second calving. During that period, attempts had been made to breed from her, but ineffectually. 3. A small aged cow, belonging to a *farmier* near Paris, that gave milk for 3 years subsequent to her last calf. 4. A cow in the possession of Mr Nichols, postmaster, Lower Merion Street, Dublin. This animal was in Mr Nichol's possession for 4 years, during the entire of which time she continued to give an uninterrupted supply of milk, which did not diminish in quantify more than 3 pints per diem, and that only in the winter months. . . . . He disposed of her for butchers' meat, she being in excellent condition. The morning of the day on which she was killed, she gave her usual quantity of milk."†

(2139.) The same writer enters fully into a subject with which I was not previously acquainted, namely, the possibility of securing permanency of milk in the cow. This is effected, it seems, by simply *spaying* the cow at a proper time after calving. The operation consists in cutting into the flank of the cow, and in destroying the ovaries of the womb by the introduction of the hand. The cow must have acquired her full stature, so that it may be performed at any age after 4 years.

* Quarterly Journal of Agriculture, vol. iii. p. 310-313.

† Ferguson on Distemper among Catttle, p. 29.

She should be at the flush of her milk, as the future quantity yielded depends on that which is afforded by her at the time of the operation. The operation may be performed in ten days after calving, but the most proper time appears to be 3 or 4 weeks after. The cow should be in high health, otherwise the operation may kill her or dry up the milk. The only preparation required for the safety of the operation is, that the cow should fast 12 or 14 hours, and the milk taken away immediately before the operation. The wound heals in a fortnight or three weeks. For two or three days after the operation, the milk may diminish in quantity; but it regains its measure in about a week, and continues at that mark for the remainder of the animal's life, or as long as the age of the animal permits the secretion of the fluid; unless, from some accidental circumstance—such as the attack of a severe disease—it is stopped; but even then, the animal may be easily fattened.

(2140.) The advantages of spaying-milch cows are thus summed up :—" 1. Rendering permanent the secretion of milk, and having a much greater quantity within the given time of every year. 2. The quality of the milk being improved. The uncertainty of, and the dangers incidental to, breeding, being, to a great extent, avoided. 4. The increased disposition to fatten, even when giving milk, or when, from excess of age, or from accidental circumstances, the secretion of milk is checked; also the very short time required for the attainment of marketable condition. 5. The meat of spayed cattle being of a quality superior to that of ordinary cattle." * With these advantages, of course, breeders of stock can have nothing to do; but, since the operation is said to be quite safe in its results, it may be presented to the notice of cowfeeders in towns.

(2141.) A cow will desire the bull in 4 or 5 weeks after calving. The symptoms of a cow being in season are thus well described by Skellett. " She will suddenly abate of her milk, and be very restless; when in the field with other cows she will be frequently riding on them, and if in the cow-house, she will be constantly shifting about the stall; her tail will be in constant motion; she will be frequently dunging, stalling, and blaring; will lose her appetite; her external parts will appear red and inflamed, and a transparent liquor will be discharged from the vagina. In old cows these symptoms are known to continue 4 or 5 days, but in general not more than 24 hours, and at other times not more than 5 or 6 hours. Therefore, if a cow is intended for procreation, the earliest opportunity should be taken to let her have the bull; for if it be neglected then, it will often be 2 or 3 weeks before the above symptoms will return. These instructions," adds Skellett, " are necessary to be given only to the proprietor of a small number of cows, where a bull is not always kept with them. . . . If a cow, after calving, shews symptoms of season sooner than 4 or 5 weeks, which is sometimes the case, she should *not be permitted to have the bull sooner than 4 or 5 weeks from that period*, for the womb before that time is, in general, in so relaxed a state, as not to be capable of retaining the seed, consequently she seldom proves with calf, if she is suffered to take him sooner."† This last remark I consider of great value, for I am persuaded that most cases of cows not holding in calf the first serving after calving, arises from the want of consideration on the part of breeders, whether the cow is in that recovered state from the effects of calving, as to afford a reasonable hope that she will conceive; and

* Ferguson on Distemper among Cattle, p. 36.

† Skellet on the Parturition of the cow, p. 11-13.

this is a point more to be considered than the mere lapse of time after calving, for a cow after a severe labour may be in a much worse state for conception, even at double that length of time, than another which has passed the calving with ease, though the former may come as regularly into season as the latter. The state of the body, therefore, as well as the length of time, should be taken into consideration in determining this point.

(2142.) There are still other considerations connected with the serving of cows which deserve your attention. The usual practice, in places where there is no bull, is to take the cow to the bull at a convenient time for the cattle-man to go with her; and, should she have passed the bloom of the season before her arrival at the bull, the issue is of course doubtful. The cow may have travelled a long distance and become weary, and yet no rest is allowed her, and she must undergo the still further fatigue of being served. Some people cannot be satisfied with the service which their cows receive, until both cow and bull are wearied out. Others will force either the cow or bull, or both, together against their inclination, she being held by the nose, and he goaded on with threats and thumps. In all such cases the chances are much against conception. There is, to be sure, the difficulty of not having the bull on the spot, but, when he is reached, he may have been worn out for the day by previous service. No such difficulty is felt when there is a bull at home; but even then, when the cow has to be taken to him out of the byre, for example, some judgment is requisite of the proper time at which she should be taken out; and this can only be ascertained by studying the idiosyncrasy of every cow, and remembering each case. It appears to me to be as essential a matter to keep a record of the characteristics of each cow, in regard to her state of season, as of her reckoning to calve: and this remark is strengthened by the great differences, in this respect, evinced by different cows under the same treatment. For example, one arrives soon at mature season after the symptoms are exhibited, another requires a few hours to arrive at the same point, and the season continues for some time longer in a languid state. A third runs through the course of season in a few hours, while a fourth is only prepared to receive the bull at the last part of her season. A fifth may exhibit great fire in her desire, which induces her keeper to have her served at once, when too soon; whilst another shews comparative indifference, and, in waiting for an exhibition of increased desire on her part, the season is allowed to pass off; and when this is the case, some cattle-men, conscious of neglect, and afraid of detection, will persist in the bull serving her, though she may be very much disinclined for the embrace, and does every thing in her power to avoid it. There is no way so natural for a bull serving a cow, as when both are in the field together, and understand one another. The most proper time is wisely chosen by both, and failure of conception will be rare in the circumstance. But it is possible that the bull may be unable to obtain possession of the cow in the field, by reason of disparity in height, and of corporeal conformation; in which case he will require to be taken to a part of the ground which will favour his purpose. Two or three *thorough* skips are quite sufficient for the purposes of conception. The cow should be put into and kept quiet in the byre after being served until the desire leave her, and she should get no food or water for some hours after, as any encouragement of discharges from the body at this time, by food and drink, is inimical to the retention of the semen.

(2143.) "When nature is satisfied," says Mr Skellett, who is a great authority in the vaccine department of veterinary practice, "or the symptoms of season

disappear in the animal, conception has taken place. The neck of the womb becomes then completely closed by a glutinous substance which nature has provided for that purpose, being perfectly transparent, and with difficulty separated from the parts. This matter is for the purpose of excluding all external air from the mouth of the womb during gestation, which, if admitted to the fœtus, would corrupt the membranes and the pellucid liquor in which the fœtus floats, and would undoubtedly cause the cow to slink. This glutinous substance also prevents the lips of the mouth of the womb from growing together; and when the cow comes into season, it becomes fluid,—in the act of copulation serving to lubricate the parts, and prevent inflammation." *

---

47. OF THE ADVANTAGES OF HAVING FIELD-WORK ALWAYS IN A FORWARD STATE.

"Who breakesh timely his fallow or ley,
Sets forward his husbandrie many a waye.
This, timely well ended, doth forwardly bring
Not only thy tillage, but all other thing."

TUSSER.

(2144.) The season—*early spring*—having arrived, when the labouring and sowing land for the various crops cultivated on a farm of mixed husbandry are about to occupy all hands for several months to come, the injunction of old Tusser, to undertake them in time that each may be finished in its proper season, should be regarded as a sound advice; for whenever your field labour is advanced ever so little at every opportunity of weather and leisure, no premature approach of the ensuing season can come upon you unawares; and should the season, on the other hand, be delayed beyond its usual period, by natural causes, you will be *ready* to proceed with your work whenever the weather proves favourable. When work advances little by little, there is time to do it effectually; or, if it be not then executed in an effectual manner, you have yourself to blame for not looking after it. When I say, however, that work may be advanced little by little, I do not mean that it should be done in a slow, careless manner, as if the work-people were unimpressed with the importance of what they were doing. The advantage of doing even a little is that whatever is done is not to do afterwards; and that a little may be done as *well*, and in as short a time, as if it had been

* Skellett on the Parturition of the Cow, p. 17.

done as a part of a great operation. In this way, even if only one man is kept constantly at the plough, he would turn over, in the course of a time considered short when looked back upon, an extent of ground almost incredible. He will turn over an imperial acre a-day, that is, 6 acres a-week, 24 acres in a month, and 72 acres in the course of the dark and short days of the winter quarter. All this he will accomplish on the supposition that he has been enabled to go at his plough every working day; but as that cannot probably happen in the winter quarter, suppose he turns over 50 acres instead of 72, these will still comprehend the ploughing of the whole extent of ground allotted to be worked every year by each pair of horses when the farm was taken. In fact, here is a large proportion of a whole year's ploughing done in a single, and in the shortest, quarter of the year.

(2145.) Now, a week or two may quickly pass in winter, in doing things of little moment, and which, in fact, amount to time being thrown away; such as sending away a rake of all the draughts to a stock corn-market, on a day when there is little prospect of disposing of the grain, and when they would have been better employed at home at the plough; or driving some material on the farm, which would better and easier be done when the ploughs are laid idle at any rate by frost; or in setting men to the corn barn to thrash or clean corn, and laying the horses idle for the time; or in contriving some unimportant work to fill up the time for half a day, until the frost thaws a little on the lea, because it would give too much trouble to take the ploughs from the lea to the stubble field, if there be any such at the time. Sharping and setting irons differently may form a reasonable excuse for shifting the ploughs from a stubble to a lea field, but no such excuse is available in neglecting to make the opposite transference. Such omissions and instances of misdirected labour are too much regarded as trifles *in winter;* but it is undeniable that they occupy as much *time* as more important work; and in a season, too, when every operation of the field is preparatory to one at a more busy season. Occasionally the state of the work will force the consideration on the farmer, that it is not so far advanced as it should be, or even as he could wish, still, instead of pursuing a different course from what has given rise to the reflection occasioned by the delay, his unsatisfied mind consoles itself with the assurance, that when the season for active work actually arrives, the people will be able to make up for the lost time. This is, however, mere delusion; for if work can be made up, so can *time*, the two being inseparable; and yet, how can lost time be made up, when every moment of the year has its work to perform, and when that period, long as it is, is usually found too short in which

to do *every* thing as it *ought to be done?* "There's the rub." For time eludes pursuit, and brooks no interruption; but neglected *work*, though *attempted* to be overtaken, and *it* may be overtaken before its issue, still the race will never terminate *in a satisfactory manner*. The neglected work may, no doubt, be done in a short time—in an unprecedentedly short time; but in that case it is the time in which the work is done that is boasted of, not the work itself,—the measure, and not the thing measured, which is held up to view; and yet, time being the standard by which all well-executed labour is measured, it cannot be deprived of that property, whatever devices may be used to make it go beyond its steady pace. You should remember that *its* pace is the same in winter as in summer, and the extent of labour, measured by the length of its tread, ought to be as great in winter as in summer, otherwise an irreclaimable error is assuredly committed in that season.

(2146.) Convinced that *field*-labour should be perseveringly advanced in winter, whenever practicable, I am of opinion that plan is good which appoints ploughmen to different departments of labour; some to work constantly on the farm, others occasionally to go from home; some to be constantly, or nearly so, at the plough, others frequently at the cart. Thus the benefits of the subdivision of labour may be extended to the farm. When a certain proportion of the draughts are thus set aside for ploughing, *that most* important of all operations will not only be well done by those whose special duty it is to do it, but perseveringly and judiciously done. This proportion is only legitimately employed at any other work when there is no ploughing for them to execute. Ploughing being a steady occupation, not subject to the irregular action of the cart, can be performed by the older men and horses, who cannot so well bear the shocks of carting as younger men and horses.

(2147.) It may be proper to give some familiar examples of what I mean when I say, that *field*-labour should be advanced at every opportunity. The order of work in spring is well understood; it should therefore be the study of the farmer to conduct the operations of winter so as to suit those of spring in their natural order. If the weather seems tempting to sow spring-wheat, then a portion of the land cleared of turnips by the sheep, best suited to that species of crop, should be so ploughed as to answer wheat instead of barley. If beans are desiderated as a crop, and there is land suitable for their culture, then, in autumn or in early winter, the stubble land, in its particular state, should be so ploughed as to suit their growth; and in whatever mode beans are to be afterwards cultivated, care should be taken to have the land particularly dry, by letting off water in winter by additional gaw-

cuts, where necessary, or by deepening those already existing, where they seem to require that amendment. Beans being an early crop, such precautions to render land dry on the surface are requisite. If common oats are to be sown in spring, they being sown earlier than the other sorts, the lea intended for them should be ploughed first, and means taken to keep it dry in winter, so that the most unpropitious weather in spring may not find the land in an unprepared state. What land is intended for potatoes, what for turnips, or tares, or bare fallow, should be prepared in their respective order; and when every one of all these objects have been promoted, and there is found little or nothing to do till the burst of spring-work comes, both horses and men may enjoy a day's rest now and then, without incurring the risk of throwing work back; but before such recreations are indulged in, it should be ascertained that all the implements, great and small, have been repaired for work—the plough-irons all new laid—the harrow-tines new laid and sharpened, and fastened firmly into the bulls of the harrows—the harness all tight and strong—the sacks new patched and mended, that no seed-corn be spilt upon the road—the seed-corn thrashed, measured up, and sacked, and what is last wanted put into the granary—the horses new shod, that no casting or breaking of a single shoe may throw a pair of horses out of work for even one single hour—in short, to have every thing prepared to start for work when the first notice of spring shall be heralded in the sky.

(2148.) But suppose the contrary of all this to happen; suppose that the plough-irons and harrow-tines have to be laid and sharpened, when perhaps to-morrow they may be wanted in the field—a stack to be thrashed for seed-corn or for horse's-corn in the midst of the sowing of a field—suppose, too, that only a week's work has been lost, in winter, of a single pair of horses, and the consequence is, that 6 acres of land have to be ploughed when they should be sown, that is, a loss of a whole day of 6 pair of horses, or of 2 days of 3 pair—suppose all these inconveniences to happen in the busy season, and the provoking reflection occurs that the loss incurred now was occasioned by trifling offputs in winter. Compare the value of these trifles with the risk of finding you unprepared for sowing beans or spring-wheat. Suppose, once more, that instead of having turnips in store for the cattle, when the oat-seed is begun in the fields, and that, instead of being able to prosecute that indispensable piece of work without interruption, you are obliged to send away a portion of the draughts to bring in turnips, which *must be brought in*, and brought in, too, from hand to mouth, it being impossible, in the circumstances, to store them. In short, suppose that the season of incessant labour ar-

rives and finds you unprepared to go along with it,—and what are the consequences? Every creature about you, man, woman, and beast, are then toiled beyond endurance every day, not to *keep up* work, which is a lightsome task, but to *make up* work, which is a toilsome task, but which you said you could easily do, when you were idling your time in a season you consider of little value; and, after all, this toil is bestowed in vain to obtain the end you wish, namely, to prepare your crop *in due season.* You who are inexperienced in the evils of procrastination may fancy this to be an overdrawn picture—even an impossible case; but unfortunately for that supposition, it is drawn from the life. I have seen every incident occur which I have mentioned, both as to work being in a forward and in a backward state, not, it is true, in any one year, but some incidents in one, and some in another year; but what may occur in different years may all occur in one, and such a result may easily be realized by indulgence in increased negligence.

---

48. OF CROSS-PLOUGHING, DRILLING, AND RIBBING LAND.

"The new-gained field laid down in seemly drills."

GRAHAM.

(2149.) I have already described the various modes of ploughing land at the commencement and during winter, from page 464 to page 482 of the first volume. It remains for me to describe other modes of ploughing, which were deferred from that time until the season in which they are usually begun to be executed, namely, spring. These modes are cross-ploughing, drilling, and ribbing.

(2150.) And, first, as to *cross-ploughing.* In (1841.) it will be found that I have alluded to this mode of ploughing, not so much to describe it minutely, as to deprecate its practice before winter. "Its object," as I have said, "is to cut across the existing furrow-slices into small pieces, that the land may be the more easily pulverized and prepared for the future crop." Fig. 368 represents a field to be cross-ploughed, and it is purposely formed of an *irregular* shape, as most fields are, to shew the side from which the cross-furrows should be feered, and the mode of ploughing the last, or irregular feering, according to the circumstances of the case.

(2151.) The first thing to be done in preparing any field for cross-ploughing is to render its surface as free of large clods as possible; and this is effected by *harrowing*, an operation which is executed by an implement that will be particularly described, when it comes to be spoken of in seed-time. The winter's frost may have softened the clods of the most obdurate clay-soil, and the mould-board of the plough may be able to pulverize them fine enough, and the lighter soils may have no clods on them at all; from all which circumstances, it may be regarded as a loss of time to harrow the ground before cross-ploughing it in spring, and, for these reasons, I believe, some farmers do not practise harrowing; but it appears to me to be always the surest plan of pulverizing the soil to harrow it before cross-ploughing the winter furrow; because you cannot be sure that, in the strongest land, all the clods have been softened to the heart by frost; and should they happen still to be hard there, and become buried by the cross-furrow, they will not be so easily pulverized as when lying exposed upon the surface of the ground to the action of the harrow; and even in the lightest soils, the harrows not only make a smoother surface, but assist in intermixing the dry frost-pulverized soil of the surface with the moister and firmer soil below, at least as far as the tines of the harrows reach.

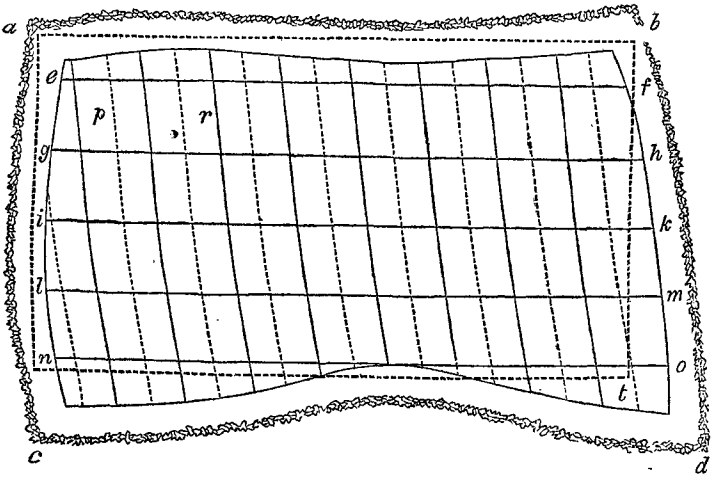
(1252.) There is not much time lost in harrowing before cross-ploughing; for although the harrowing should be given a *double tine*, that is, backwards and forwards upon the same ground, to pulverize the clods, or equalize the texture of the ground; and although it should be given *across* instead of along *the ridges*, that the open furrows may be filled up with soil as much as possible, whether the land had been ploughed with gore-furrows, fig. 136, or not—that which has been cloven down with gore-furrows, fig. 141, or twice gathered up, fig. 139, being the most difficult to cross-harrow, not only on account of the numerous open-furrows of the former method, and the inequality of the ground, occasioned by the latter, but because both these methods are adopted for winter furrows on *strong* land, which is the most difficult to be laboured even in the most favourable forms—yet the worst form of ploughed land can be harrowed in a short time.

(2153.) Two pairs of harrows should be set to cross-harrow together, as being the best mode of accomplishing effective harrowing in all cases, as will be shewn afterwards; and that number of harrows, when unconfined by ridges, will cover at least 16 feet in breadth, and proceeding at the rate of 2 miles per hour, for 9 working hours, will give 19 acres of ground a double tine, on the supposition there have been no interruptions; but as time must be lost in turnings, as you have already seen

in ploughing (1149.), and a breathing occasionally given to the horses, that quantity of land cannot be harrowed a double tine at that rate of travelling, in the ordinary mode of conducting labour; but say that 16 acres are thus cross-harrowed in the course of a day, a half day's harrowing will make room for a number of ploughs.

(2154.) If time presses, the feerings for cross-ploughing can be commenced almost immediately after the harrows have started; and if these cannot get away before the plough, it can either take a bout or two in each feering, till the harrows have passed the space for the next feering, or the harrows can pass along the lines of each feering before the plough, and return and finish the harrowing of the ground between the feerings. Thus, in fig. 368, after the line of feering *e f*

Fig. 368.



A FIELD FEERED FOR BEING CROSS-PLOUGHED.

has been harrowed, the plough can either take a bout or two around it, till the harrows have passed the next line of feering *g h*; or the harrows can go along each line of feering, first *e f*, then *g h*, then *i k*, and so along *l m* and *n o*, in succession, to prepare the ground for feering, and then return and harrow out the ground between *e* and *g*, *g* and *i*, *i* and *l*, and *l* and *n*. In this way the harrowing, and feering, and the ploughing of the different feerings, can be proceeded with at the same time. But if time is not urgent, the systematic mode is to harrow the field in a continuous manner, beginning along the fence *a b* from the gate at *b*, and proceeding by breadths of the harrows across the field till the other

side of it *c d* is reached; or another equally effective mode is to step off feerings from *a b*, in breadths of 30 yards in succession, along the field, in the manner I am about to describe, for cross-ploughing; and this mode has the advantage of giving an easier turning to the horses at the landings.

(2155.) Suppose, then, that all or as much of the field to be cross-ploughed has been harrowed as will give scope to a single plough to make the feerings without interruption. In choosing the side of the field at which the feerings should commence, it is a convenient rule to begin at the side farthest from the gate, and approach gradually towards it, and its convenience consists in not having to pass the finished feerings, and so to avoid the risk of trampling on the ploughed to get at the unploughed land. The convenience of this rule is felt not only in cross-ploughing, but in prosecuting every species of field-work; and besides avoiding the risk of damage to finished work, it is gratifying to the minds of labourers to think, that, as their work proceeds, they approach the nearer home; while it conveys to others the idea of a well laid plan, to witness the operations of a field which have commenced at its farthest end, and are finished at the gate, where all the implements employed meet, ready to be conveyed to another field. The gate in this instance is like home, and in most cases it is placed on that side or corner of the field nearest the steading. In the particular case of the field represented by fig. 368, these conveniences are not all available, owing to its form, which is a very common one; and peculiarities of form involve considerations in regard to conducting field operations of more importance than mere convenience, and one of these is the most important one of loss of time. It is always desirable to commence a feering at a *straight* side of a field, whence there is little risk of error in striking off the feerings to include parallel spaces of ground; and where this particular is not attended to, much time is needlessly spent in ploughing a number of irregular pieces of ground. It is better to leave any irregularities in ploughing to the last; and as an irregularity must occur, at all events, along the side of a crooked fence, it is saving of time to throw any irregular ploughing to that side. In fig. 368 it so happens that the straightest side of the field is nearest the gate at *b*, and the crooked fence, *c* to *d*, farthest from it. In pursuance of the rule just announced, the feering should begin along the side of the straight fence *a b*, and terminate in an irregular feering along the crooked fence *c d*. A straight feering could, no doubt, be made at first along *c d*, leaving any irregularity between it and the fence; but the setting off of that feering *parallel* with the straight fence *a b*, in order to

avoid making an irregularity there also, would impose considerable labour, and take up more time than the advantage would compensate of avoiding the inconvenience of having to pass ploughed ground.

(2156.) Let the first feering, then, be made about 7 or 8 yards from the fence *a b*, or from the ditch-lip of that fence, if there be a ditch there. Some farmers neglect the head-ridge in the cross-ploughing, and measure the feering from the open furrow between it and the ends of the ridges. I maintain that the head-ridges should be ploughed at this time, as well as the rest of the field, for if they are neglected now, the busy seasons of spring and of early summer will prevent attention being paid to them till, what with the trampling of horses in working the land for green crop, and the probable drought of the weather in those seasons, will render them so very hard, that it will be found impracticable to plough them, and they will thus be deprived of the ameliorating effects of the sun and air during the best part of the year. Let them, therefore, be included in the cross-ploughing, although they cannot be *cross*-ploughed themselves. But if it is desired to plough them with the side-ridges, which form the head-ridges to the cross-ploughing, and which side-ridges must be ploughed before the crop, whatever it may be, can be sown upon them, then the head-ridges may be left out of the feering, and the first feering be struck at 7 or 8 yards from the head-ridge open furrow. Suppose that this line of feering is *e f*; and as it is executed in the same way as that already described in feering-ridges in (820.), I refer you to that paragraph, as well as to fig. 132, where the furrow-slices *m n* are shewn to be thrown out right and left from the line of feering *k l*. The next line of feering is *g h*, at 30 yards' distance from *e f*, and so there is a feering at every 30 yards' distance, to the last feering *n o*.

(2157.) After as many feerings are struck as there are ploughs to be employed in cross-ploughing, each plough enters a feering, and first lays the furrow-slices of the feering together, to form the crown of the future cross-ploughed break of land. The horses are *hupped* around each feering *e f*, *g h*, &c., till about $\frac{1}{4}$ of each break of land is ploughed, that is, $\frac{1}{4}$ from *e* towards *g*, and $\frac{1}{4}$ from *g* towards *e*, thus ploughing $\frac{1}{2}$ the break between *e* and *g* by *hupping* the horses. The remaining $\frac{1}{2}$ of the break, between *e* and *g*, is then ploughed by *hieing* the horses (1120.) from *e* to *g*, and from *h* to *f*, till the middle, between *e* and *g*, is gained by an open-furrow. No open-furrows, however, are left in cross-ploughing, these being ploughed together again by 2 or 3 bouts, lessening the size of each furrow in every bout, till the last one is closed up by the mould-board of the plough, which is laid over on its side, and dragged forward while the ploughman holds only by the large stilt. The oblite

ration of the open furrow is necessary to avoid any hollow that would be left there across the ridges, when they are again ploughed into form. I have alluded to this subject before in (841.).

(2158.) The ploughing of the complete feerings is all plain work, and, indeed, the only difficulty encountered in cross-ploughing is when the last or irregular feering, such as *n o*, is reached. This feering is begun to be ploughed like any of the rest, till the nearest point to the open-furrow of the head-ridge is attained, and if the head-ridges have been included in the feerings, then the ploughing proceeds till the ditch-lip or hedge-root stops the plough; but if left to be ploughed with the side-ridges, a small feering should be made at the lowest points of the ridges at the head-ridge furrow, and the break included between these points and the feering should be ploughed out by *hieing* the horses, with a long furrow on the one side and a short one on the other, till the middle is gained, where the open-furrow is closed up like the others. This feering will take longer time to plough than any of the rest, in proportion to the quantity of ground turned over in it, on account of the plough having to go empty from the bend of the fence to the points on both sides.

(2159.) Had the field been a true rectangle, like the space included within the dotted lines *a n b t*, the feering might have been struck from either fence, and there would have been no loss of time in ploughing alternate long and short furrows. Scarcely a more striking comparison can be made of the loss of time occasioned in ploughing land of the same extent than between a field of regular and irregular form, at a busy season. The letters *p* and *r* indicate single and double ridges.

(2160.) The furrow given at cross-ploughing is always a deep one, deeper than the one given at the commencement of winter; and this is easily accomplished, as the land not having had time to consolidate, nor any labour executed upon it to consolidate it, the plough passes easily under the old furrow, and not only turns it over again, but raises a portion of the land below it. Indeed, it is requisite to make the plough take hold of this firm substratum in order to keep it steady, otherwise the formerly turned-over furrows, which are still cloddy, or the unrotted stubble, which has been buried by the plough, may form obstacles under and on both sides of the plough so as to throw it out of operation altogether, or at least so affect its motion as to prevent its maintaining an equal depth of furrow. Perhaps 9 inches may be considered a good average depth in cross-ploughing with a pair of horses.

(2161.) But means are frequently used at this season to cross-plough with a deeper furrow than can be reached by a plough drawn by a pair of horses, 3 or 4 horses being employed for the purpose. The *third*

horse is very commonly yoked in front of the furrow horse of the plough, and harnessed in the cart-traces, as represented in the trace-horse of the cart in Plate XVIII, the hooks of the trace-chain being passed into a link of the plough-chains, behind the haims, of the rear horse. A simpler plan still is adopted by only using the plough harness, and lengthening the plough-chains by *short-ends*, that is, short pieces of chain, which are hooked in a similar manner to that just described. Neither of these methods, however, will bear a comparison in point of draught with the yoking of 3 horses, as represented in fig. 201, and described in (1128.) I have an objection, however, to this mode of yoking, which is founded, not on its principles, which are faultless, but on account of an inconvenience to one of the horses. When so yoked, the 3 horses work nearly a-breast, the middle one being only a little in advance of those on either side; and the objection is, that the middle horse will become more heated in the work, in that position, than either of the other two. This inconvenience may not be much felt in early spring-work, but at the time when the largest proportion of cross-ploughing is usually executed, or in summer, the middle horse must suffer considerably more than the others, and this result I have frequently witnessed in places where 3 horses are still yoked a-breast to the harrows. There are various modifications of yoking 3 horses practised in different parts of the country, to which reference has already been made in (1129.), (1130.), and (1131.), and where will also be found methods of compensating the labour of any individual horse by an alteration of the swing-tree, when unequally yoked, which one of the horses is, when 3 are made to work together, as they are usually yoked in tandem fashion. Three horses will take a depth of furrow of 11 or 12 inches, according to the texture and depth of the soil.

(2162.) A still greater depth may be attained, and is frequently desirable in cross-ploughing, and there is no other sort of ploughing which affords such facilities for obtaining a deep furrow. This greater depth is attained by yoking 4 horses to a plough, 2 leading and 2 following, the 2 off ones walking in the furrow, and the 2 near ones on the firm land. Two very convenient and efficient modes of yoking 4 horses may be seen in figs. 202 and 203, and a description of them is given in (1132.) and (1133.). Yoked as in fig. 202, the leading horses are best harnessed, as in the traces of the cart, Plate XVIII; but, as in fig. 203, they may be in their usual plough harness, with the exception of the chains, which are made for this particular mode of yoking. The depth reached by a 4-horse plough is, on an average of soils, 14 inches. I have used the 4-horse plough much, and with *stout* well-

matched horses have never reached less than 14 inches in obdurate subsoils; while in freer soil and substratum, not properly a subsoil, but rather an undisturbed soil, the plough went to 16 inches of perpendicular depth, and the work was most satisfactory.

(2163.) An ordinary stout plough will answer for 3 horses, and so it may for 4, where there are no boulder stones in the land; but where a considerable quantity of 4-horse ploughing is desired to be executed, it is better to have a plough made for the purpose a little stronger than the ordinary 2-horse plough.

(2164.) In a 3-horse yoke, one man may drive all the horses by means of reins or by the voice, though a boy to assist at the turnings will save as much time in that matter as will compensate for his wages. Where 3 horses are yoked a-breast, one man may as easily manage them as 2 horses. In the case of 4 horses, however, there should be a man to drive the horses, and this is usually done with the whip instead of reins, though the near leader should have a rein. The second man, in this case, is no loss, as the 4 horses just constitute 2 pairs of the ordinary draughts. Even if the second man were taken away from his horses, —which should never be the case—and set to other work, he would be of little service, as his mind would be constantly occupied with the desire to know how his horses are getting on under the guidance of another man. But the fact is, that no man can manage 4 horses at the plough with advantage to the work. Fig. 206 shews how a 4-horse plough may be yoked and driven.

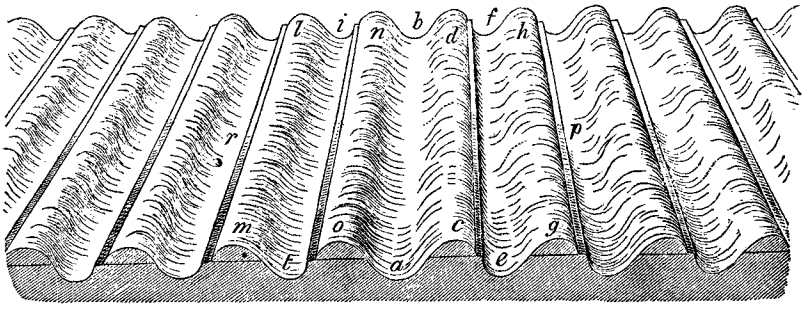
(2165.) This deep cross-ploughing with a 3- or 4-horse plough should not be confounded with trench-ploughing, which is best and usually performed as represented in fig. 206. Trench-ploughing only deserves the name when a common plough goes before and turns over a furrow-slice, and in the bottom of which the 4-horse plough follows and goes as deep as it can. In deep-ploughing the 4-horse plough goes as deep as it can of itself, and it is rare that it meddles with the subsoil, which it is the special object of trench-ploughing to disturb. Deep-ploughing will be very well executed by one common plough following another in the same furrow; and when the substratum is free, this is a very good way of stirring up the soil to the moderate depth of 10 or even 12 inches.

(2166.) The 3- and the 4-horse ploughs should not be inconsiderately employed in cross-ploughing in spring, because either mode of ploughing occupying a considerably longer time with the same number of draughts, and employing more horses than ordinary ploughing, it cannot be prudently employed on land that is immediately to be occupied by an early spring crop, such as beans, though the time in which potatoes,

turnips, and fallow are respectively finished, will afford plenty of leisure to have the land appropriated to them deeply cross-ploughed in the best manner.

(2167.) Next as to *drilling*. This is a form of ploughing very different from the ordinary, but it is not unlike that mode of ploughing stubble in some parts of the country which is represented by fig. 142, and which I alluded to only to condemn. The principal reason for my condemnation of it was, that, while it professed to turn up the soil to the action of the atmosphere, it buried more than half of it untouched by the plough, thus in a great measure running counter to its own avowed object. On comparing fig. 369 with fig. 142, the *form* of the two modes of ploughing are

Fig. 369.



THE MODE OF PLOUGHING SINGLE DRILLS.

somewhat similar, but in their structure, that is, in the state of the soil within and without, they are very different. In fig. 142, the ground *b* is quite solid and unmoved from the state in which it had borne crops, and the moved parts *a* are full of stubble and weeds. The lines of the drills *c* are quite irregular, having no reference to the quarters of the compass, the direction of the ridges, or in parallelism with themselves. The regular drill, on the other hand, is formed of deep loosened soil, ploughed and harrowed on purpose, and made as clear of weeds as the time allotted to prepare the soil will allow. Drilling is a finished piece of work, the other only confessedly a preparatory one. Drilling is essential to the proper cleaning of the land at a future period of the season, the other a very questionable mode of attaining any good object.

(2168.) I have said, that before land is drilled it should be well pulverised, well cleaned, at least as well as the time when it should be drilled will allow; and the ground should be in a soft state by labour when drilling is to be executed, otherwise the drills will not have their pro-

per form and structure. Drills should not be formed on hard land, nor ought they to be attempted to be formed on hard land, as the object of making them at all, is, in the first place, to afford a sufficient quantity of loose soil to cover the manure deposited in them; in the next place, to afford the roots of plants sufficient freedom to roam in search of food; and, in the last place, to afford opportunity, notwithstanding the presence of a crop, to free the land of weeds, by stirring it occasionally with proper implements. There is no way of effecting all these objects so effectually as by drilling. Accordingly, all crops intended to meliorate and clean the ground are cultivated in drills, and these are what are called green crops, namely, potatoes, turnips, mangel-würzel, beans, &c.

(1269.) After land has been much ploughed and harrowed, and even rolled, to render it friable, it is usually in a flat state, whatever may have been the form in which it had before been ploughed; and when flat, it is in the best state for being ploughed into drills. Yet strong land that is constantly retained in ridges of a rounded form, that is, twice gathered up, fig. 139 and (839.), will exhibit the form of ridges, even after it has been well pulverized by ploughings, harrowings, and rollings; it will still appear as if gathered up from the flat, fig. 133, and it had been harrowed and rolled fine on the surface. Lighter soil with the same work will appear quite flat, that is, of a uniform surface throughout, not as if it were level. This distinction in the appearance of the ground of being ridged or not ridged, should be kept in view, as it will, in great measure, determine the width of space that should be left between the drills; and it is entirely occasioned by the difference of the form in which the different sorts of soils had been previously ploughed. Strong soil is always kept round by repeated gatherings up, or gatherings up based on casting with gore-furrows, figs. 135 and 136; whereas the lighter soils are usually only once gathered up, fig. 133, cast together without gore-furrows, fig. 135, or ploughed two-out-and-two-in, fig. 138.

(2170.) In whichever of these states the land may be, whether completely flat or exhibiting a slight indication of rounded ridges, the drills are made of the same form; and they are formed in the following various ways. They are made by one landing of the plough, when they are said to be *single*, or they are made with a bout of the plough, when they are called *double;* and both single and double drills are made either *towards* or *from* the *feering*. The ultimate form of the two different modes are apparently the same, but that which makes them *from* the feering is nevertheless the best, as I shall shew in the sequel.

(2171.) In beginning to make drills, let us take one of the simplest

cases that present themselves, namely, a field having a straight side at its farthest end, and having the forms of ridges still visible; and as it is requisite in strong land to preserve a form that will keep it as dry as possible, the drills should be so formed upon the ridges as to be accommodated between their open furrows. If the ridges are 15 feet in width, 6 drills of 30 inches apart will fill up that space between the open furrows; and if 18 feet wide, 8 drills of 27 inches will answer the same end. When the ground is flat, any width of drills previously determined on may be executed. I have seen it stated in cases of drilling land for turnips in England, that only 18 inches was a good distance to be preserved between drills; but what object is gained by adopting a distance which is too narrow for the free operation of the implements required to keep the ground clean, I cannot imagine.

(2172.) Suppose, then, that the ridges present a form of 15 feet in width on strong land, they should be made 30 inches wide, and they are made in this way. Begin at the end of the field farthest from the gate, and where the fence runs in a straight line; and set up 3 feering poles (604.) in a straight line upon the nearest furrow-brow of the third ridge from the fence, and 15 inches from the middle of its open furrow. Split out the feering along the line of the poles, turning over the furrow-slices first to one side and then to the other, like the furrow-slices *m* and *n*, along the feering *k l*, fig. 132. The reason that the first feering is made on the furrow-brow is, that when the drills are split to cover the dung, or whatever else is put in them, the place which the hollow now occupies will then be filled up by the drill, and the open furrow will then be the hollow between the drills upon the furrow-brow of both ridges. In fig. 369, suppose *a b* to be the feering in the furrow-brow of the ridge. On passing up from *a* to *b*, the plough lays over the furrow-slice *c d*, and the soil having been pulverized, it crumbles down in a continuous heap upon the firmer land under it. On gaining the head-ridge at the other end of the feering, the horses are *hied*, and the plough comes down from *b* to *a*, laying over a similar furrow *n o* upon the firm land. A similar feering is made in the furrow-brow of the 6th ridge from the last, and so on upon every 6th ridge across the field; but ere the field is all feered for drilling, some of the drills are formed between the feerings, that the land may be proceeded with for the purpose it has been drilled, while the feering and drilling of the remainder are proceeded with. To proceed, then, with the drilling at the first feering, at a distance of 30 inches, this previously determined width of the drills is measured off from *a* to *e*, and this the ploughman does with his

plough-staff, or shaft of his plough-spade, as that implement is called in some parts of the country, upon which the various breadths of drills executed on the farm are notched off. The plough then proceeds from *e* to *f*, preserving a parallelism with the feered furrow *a b*, laying over the furrow-slice *g h* upon the firm ground, upon which it crumbles down in a continuous heap. On *hieing* the horses at the other end of the drills, a similar distance of 30 inches is marked off from *b* to *i*, the plough passes down from *i* to *t*, laying over the furrow-slice *l m* upon the firm ground. *Hieing* the horses again, the plough passes on to *p*, and goes by *p*, forming another drill like the others. The ploughman does not measure off the width of every drill he makes in this manner, his eye being able to keep him right for a number of drills, across which he then lays his plough-staff, to ascertain how he has been proceeding, whether the drills he has made be too narrow, or too wide, or quite the proper breadth, and then again proceeds with his work. It will be observed, from the description of this process, that one drill has been formed every time the plough has gone up in the direction of *e f*, and another every time in coming down in the direction of *i t*, with the exception at striking the feering, when the plough both went up and came down *a b*. In this way the horses are made to *hie* round *a b*, and the plough to make 2 drills every bout till 2 ridges on each side of the feering *a b* are drilled up, and the last drill will be made close beside the fence. When this takes place, the ploughman goes to the next feering, when two furrows were split out as at *a b*, and forms drills around it in the same manner till 2 ridges also on each side are drilled. Two ridges having thus been drilled to the right of the first feering and two to the left of the second, and six ridges intervening between the feerings, two ridges of the six have yet to be drilled, upon which the drills are formed by *hupping* the horses from the one set of drills to the other; but in doing this, caution is requisite to make all the drills of the exact width of 30 inches, and particularly the two last formed at the junction of the two feerings. The caution is exercised by the ploughman applying his plough-staff frequently to ascertain the breadth of the ground to be drilled, and the width of the drills themselves; and should he find that he has more or less ground than he should have for the number of drills he has yet to make, he must modify the width of each drill, so as the whole number may be very near the width, and not reserve any surplus or deficient ground to be added to, or subtracted from, the last drill alone. Another caution of not less importance is to ascertain if the ground to be last drilled is of the same breadth at both ends at the head-ridges, for if this point is not attended to, the last drill may run out to a point at

one end, and be too broad at the other. In closing every feering, therefore, the greatest caution is required to preserve the breadth of the drills.

(2173.) This is one way of forming *single* drills, and the following is another. Instead of splitting out the feering *a b*, fig. 369, as just described, the plough lays two furrows together, and forms a finished drill with an elevated ridge, in the place of the hollow furrow *a b*; and this is done by *hupping* the horses instead of *hieing* them, as in the other case. Still *hupping* the horses, and measuring off the width of the drills as formerly, the next drill is made in the direction of *f e*, laying the furrow-slice upon the firm ground, towards the open track of the plough left in making the previous drill in the same direction. The next drill is made in the direction of *t i*, again laying the furrow-slice towards the plough-track left open in forming the previous drill. The drills are thus formed around the first feering over the 2 ridges on each side, then over the 2 ridges on each side of the second feering, and the drills are closed up between them, with the precautions noticed above (2172.), by *hieing* the horses.

(2174.) The essential difference betwixt these two methods is this. In the first, the furrow-slices are all laid over *from* the feerings towards the *unploughed* land, and the horses are first *hied* and then *hupped* in finishing the feerings. In the second method, the furrow-slices are all laid over *towards* the feerings and the *ploughed* land, and the horses are first *hupped* and then *hied*. As to the treatment of the horses, there is no difference in regard to them, being *hupped* and *hied* in both cases, but there is a considerable difference in regard to the treatment of the land. In the *second* method, the furrow-slice being laid over towards the open track which the plough has made in making the previous drill, should the land be at all cloddy, and it is impossible to reduce every clod on strong land at all times, clods or stones may roll down the crumbling furrow-slice, acquiring an impetus by the action of the ear of the mould-board, into the hollows between the drills; and this is no imaginary inconvenience, for clods and stones actually roll down into the said hollows, when they happen to be numerous, or when the soil is so firm as to acquire a considerable force of the plough to elevate it into drills, and when it is apt to rise in large masses before crumbling down in its fall from the mould-board. When the width of the drills is as much as 30 inches, this inconvenience is less likely to happen, but when the more usual width of 27 inches is adopted, I have seen it occur to a considerable degree. The immediate inconvenience occasioned by these clods is, that they interrupt the progress of the bean-barrow when the land is drilled

up in this way for the bean-crop; and when the land is dunged, they occupy the best part of the drill, and being there covered up with the dung, they remain amongst it, and form obstructions to those roots of plants that may be pushing through the manure in search of farther sustenance. At all events, they can do no good.

(2175.) In the first method, on the other hand, this inconvenience is entirely avoided, and no other is substituted in its stead; for should clods and stones roll away from the furrow-slice when the drill is making, and which they will inevitably do when present, upon the open and firm land, they remain there only till the next passage of the plough, which sweeps *them* away, and at the same time leaves a small space of ground between the former furrow-slice and its track, as from *t* to *o*, &c., and which track is clear and open, ready for the bean-barrow, or the dung that may be deposited in it. The advantage possessed by the first over the second method of drilling in these respects is so obvious, that any argument in support of it appears unnecessary, and being so obvious, you should not fail to adopt this method as your invariable practice.

(2176.) When the ground is flat, that is, when the ridges are not remarkably prominent, the drills are made the common width of 27 inches, some make them 28 inches, and the feering is conducted in the same way; but in setting off any feering from the last one, when there is no such guide as the breadth of ridges to measure the proper distances, care should be taken to set off such distances as will contain a determinate number of drills of the fixed width, otherwise an error will inevitably occur at the closings of the feerings. Thus, if the drills are 27 inches in width, in a feering of 30 yards broad, 6 ridges of 15 feet, each making a very convenient breadth of feering, the number of drills will be exactly 40.

(2177.) So much for single drilling; now for *double*. For this mode the feering is made in a different manner from that for the single mode of drilling. Supposing, again, that the ridges are visibly marked in the ground, the feering is taken from the furrow brow of the ridge nearest the fence, at 15 inches from its extreme outer edge, and there setting up a straight line of poles, split out the feering as before by the ploughing passing up and down in the same furrow. Suppose this furrow to be represented by the line *e f* in fig. 132, then set up a square-table at *d*, and mark off therefrom a line with poles at right angles in the direction of the arrow through *s* to *t*. Removing the square-table to *g*, set off a similar and parallel line in the direction of the other arrow through *u* to *v*. Split out both these lines with the plough as straight as the ploughman can, and the bottom of the furrow in them will form a guide

to set off the requisite widths of drills at right angles to the feering, at least they will serve to check the ploughman in his making the drills correct. Ploughmen expert at drilling are apt to contemn such guides in forming double drills, because they conceive they can preserve the widths sufficiently well by the eye, and no doubt ploughmen are to be found who drill with precision, and I have met with such, though very few in number, but the generality of them cannot be intrusted in this delicate task without a guide of some sort, and there is none more simple and more effective than the one I have described and recommended. And where *single* drilling is to be executed on land on which no vestige of a ridge is seen, it is quite impossible for the most expert driller to set off the feerings with sufficient accuracy. Ploughmen, I know, try to do it, and I have seen good ones nearly succeed in it, but never witnessed one who was not obliged to modify the widths of the drills at the closings. Strict accuracy in regard to drills is not required in some crops, such as in the bean and potato; but with regard to the turnip, which is sown with a machine set to a given width, unless the drills are very nearly alike in breadth at both ends, the sowing will be very imperfectly performed. The means, too, of attaining accuracy is so simple—merely drawing two or three furrows across the field—that it is culpable to neglect it. There will be, I am certain, more time spent by the ploughman in measuring the widths of drills with his plough-staff at every closing, than he would spend in drawing a few cross-furrows at first; and after all his adjustments, his mind is not satisfied that he has done the work in the most accurate manner. It is true, that with all the assistance cross-furrows can afford him, he will still have to measure the widths of drills with his plough-staff at every closing, but he is much less likely to err in his measurements while having the cross-furrows to guide him at right angles to the direction of the drills, than in measuring at random in a supposed right direction. This is so self-evident, that your mind must assent to the facilities afforded by cross-furrows.

(2178.) The double drills are formed in this way, on the supposition that ridges are visible at 15 feet asunder; and this method is analogous to the first method of feering single drills. After the furrow-slice *c d*, fig. 369, is laid over at the feering of *a b* along the furrow-brow of the ridge nearest the fence, the horses are *hupped*, and the plough is made to come down at the prescribed width of the drills, namely, 30 inches, along the line *f e*, and to put a furrow-slice against the other furrow-slice *c d*, which had just been turned over upon the firm ground, and in doing this the drill receives a somewhat sharp-pointed crest. At 30 inches this crest is never very sharp, but at 27

inches it may be made as sharp as you please, by making the plough go a little deeper. Then *hieing* the horses, the plough again goes along *e f*, but in the opposite direction, and lays over the furrow-slice *g h* on the open ground. *Hupping* again, the horses come down *p*, and form the other side of the drill *h g*; and so on one drill after another. No breaks of feerings are required in this mode of drilling, as every drill is finished as it is formed, and the precautions required are, that the proper widths of the drills are preserved throughout their lengths, in which they may be easily checked by the assistance of the cross-furrows.

(2179.) The other mode of double drilling is analogous to the second mode of single drilling. After the feering-poles are set up, as in the former case, the ploughing is commenced from the other headridge, and the first furrow-slice *n o* is laid over while coming down *b a*. The horses are then *hied*, and the plough is passed up the same furrow in the opposite direction *a b*, and having little earth to lay over, but a small furrow-slice is laid towards *c d*. *Hupping* the horses, the plough is then brought down *f e*, which being a fresh furrow, the furrow-slice *d c* is large, and completes the drill *d c*. *Hieing* the horses, the plough again passes along the last furrow in the opposite direction *e f*, and having little earth to take lays over the small furrow-slice towards *g h*; and then *hupping* again, a large furrow-slice is laid over from *q* and completes the drill *h g*, and so on, one drill after another, at the requisite width.

(2180.) The same difference exists in the two modes of making these double drills, or in making the single. Thus, in the first method the large furrow-slice is laid over upon the open and firm ground, and the drill is finished by the second and smaller furrow-slice; whereas, in the second method, the larger furrow-slice is laid towards the already drilled land, and upon the smaller furrow-slice which was first turned over.

(2181.) On considering carefully both modes of drilling, it will be observed that the two sides of a double drill are not equal, that side which receives the furrow-slice raised from the firm land receives a larger quantity of earth than the side which receives the small furrow-slice derived from the same track out of which the former large slice had been taken. The immediate consequence of this inequality of earth upon the two sides of a drill is to give it the form of an unequal triangle, and its effect on the growth of any seed deposited within the drill, is to cause the germ of the plant to grow out of the side at the upper part instead of the top of the drill. This effect is particularly shewn by the sloping direction which a strong growing stem of beans or potatoes

takes, and to obviate which the tops of the drills are always, in practice, harrowed down as much as to allow the stems to grow upright.

(2182.) This inconvenience of the unequal form of the double drill attends both modes of making them, but, of the two modes, that which lays the large furrow-slice upon the open side of the firm land possesses two advantages over the other; the first of which is, that no clods, large or small, can roll from the top of the drill into the hollow; and the other advantage is still greater, that of the finished drills being less trampled by the horses in making the succeeding ones. This last circumstance may be explained by referring to fig. 369. When the plough, for instance, goes up *e f* to commence a new drill, it cuts the firm ground along that line, laying the furrow-slice *g h* upon the open unoccupied ground to the right, and leaving on the left a small space of firm ground *c e* and *d f*, between the line of the plough *f e* and the crumblings of the previous large furrow or unfinished drill *c d*. In doing this, the furrow-horse walks up the hollow of the former made drill *a b* to guide him in the exact line he should go, and the other goes on the firm ground by the side of *e f*. On returning, the furrow-horse comes down *f e*, while the other comes down *p*, while the plough is making up the small side of the drill *d c*; but in doing this the footsteps of the horse that went up the finished drill *a b* are left untouched. This may be considered a matter of little importance, and from the generality of the practice, one would be led to conclude it of little importance; and in case of some horses which walk neatly and narrowly in a drill, the impressions of their footsteps may be almost unobserved in its bottom; but in the case of a horse which walks wide behind, and in that of all weak horses which stagger under their draught, both sides of the drills are frequently much trampled; and in the case of drilling strong land, foot-prints injure the soil by holding water. These may be obliterated in this way. Instead of perfecting the drills one by one in succession, let an intermediate drill remain unfinished between one that is finishing, and another that is forming. For example: Instead of finishing the second side of the drill *h g* by returning down the hollow *b a*, let the drill remain unfinished until the new drill *p* is formed so far as to lay over its furrow-slice on the firm ground. Then let the plough come down *b a*, having the furrow-horse before it, and it will obliterate its footmarks, and let the other horse come down the intermediate open furrow *f e*; because in going up and down, it is necessary in drilling that one of the horses shall go in a hollow of a drill formerly made to guide it in the proper line. With regard to the mode which lays the large furrow-slice towards the drilled land, it seems impossible but to leave the finished

drills trampled. For example: On finishing the drill *h g*, on the plough coming down *b a*, the furrow-horse walks down the finished drill *i t*, and the other walks on the firm ground down *d c*; and the same ground is gone over by the horses on the plough laying over the small furrow towards *c d* on passing up the hollow *a b*. When the plough comes down *f e* to lay over the large furrow towards, and to finish the drill *d c*, the furrow-horse comes down *b a*, and the other upon the firm land alongside *f e*; and thus the finished hollow *a b* is twice trampled, first in guiding the furrow-horse while the plough is forming the drill *d c* when coming down *f e*, and again on the plough passing up *e f* to lay the small furrow towards *h g* for the next drill, which is completed in its turn when the plough comes down *p*, and the furrow-horse tramples the finished hollow *f e*.

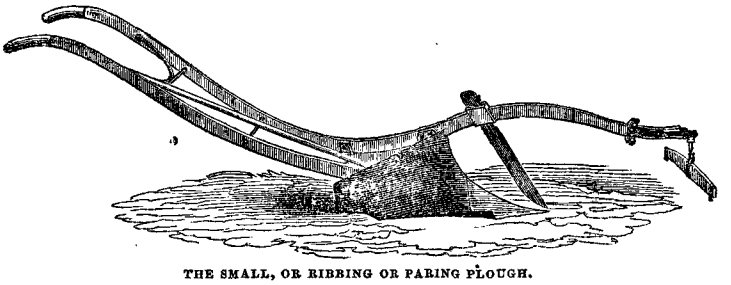
(2183.) When the ground is quite flat, double drills may be made 27 inches wide, and the same width may be adopted when ridges of 18 feet are visible, for 8 drills of 27 inches just cover an 18 feet ridge. A feering of 6 ridges of 18 feet just includes 64 drills of 27 inches, so that where drills are desired of 27 inches in width, and no more, the land, should be in 18-feet ridges, if ridged, or it should be flat, otherwise some of the 27-inch drills on 15-feet ridges will be left in the open furrow, a position which in strong land cannot fail to prove injurious to that part of the turnip crop in winter. When the soil is thorough-drained, it is of no importance where the drills are situated; but till that operation is performed, it is necessary to attend to the safety of the crop in the most unfavourable circumstance of soil by judicious management.

(2184.) It may have occurred to you to inquire, that if a perfect drill is formed by a bout of the common plough, why it is that perfect drills are not formed by one landing with a double mould-board plough? The inquiry is a natural one, and it can receive a satisfactory answer. Were a drill perfectly formed, a vertical section would give a triangle whose height is equal to half the length of the base. The height to which a common plough can elevate the crest of a drill is that of the ear of its mould-board, which, in the common (Small's) plough, Plate X., is 12 inches; and this height is conformable to a drill of only 24 inches in width. Such a plough, therefore, to make a drill of the usual width of 27 inches, will either leave a flat space on its tops of 3 inches in breadth, or it will leave a sharp crested ridglet of 3 inches in breadth at the bottom of the hollow of the drill. A common plough varies in width from the ear of the mould-board to the landside from 18 inches (Wilkie's) to 20 inches (Small's). A bout of Wilkie's plough could thus make a drill 36 inches, and that of Small's 40 inches in width in a bout,

were it ploughed to the full breadth either was capable of; but as drills are only made 27 inches in width, the second furrow is taken by the plough going nearer the side of a drill than in the middle of the hollow between two drills, and it is this expedient which gives to drills one sloping and another more perpendicular side. A double mould-board plough, constructed of similar dimensions of an ordinary one, would make drills much wider than are required; but even if its mould-boards were set as narrow as to make a 27-inch drill, it is found, that, on account of the width of double mould-board ploughs below, they cannot go so deep as to give drills their proper elevation of 13½ inches, required to bury the requisite quantity of manure deposited in them.

(2185.) There is a species of drilling executed by the small plough, fig. 370, which has received the appellation of *ribbing*. In executing

Fig. 370.



THE SMALL, OR RIBBING OR PARING PLOUGH.

this mode of ploughing, it exactly follows the mode of making single drills; and of the two modes of making these, it is necessarily restricted to that which lays the furrow-slices towards the unploughed ground, because the ribs being necessarily narrow, were clods and stones to fall into the hollows, which the other method would infallibly cause, the purpose of the ribs forming a kindly seed-bed would in a great measure be frustrated. The ribs with great pains can be formed as narrow as 9 inches, and by careless ploughmen they are made as wide as 14 inches, so that 12 inches may be considered a good medium width. They are always formed on ridges, never on the flat, and only used in seed-furrowing. The best width of feering for making them is 2 ridges, beginning on the furrow-brow of the ridges, and laying the furrow-slices into the middle of the open furrows between the two ridges; by *hupping* the horses the seed is kept out of the open-furrow, and retained upon the best land of the ridges. Ribs are formed in the length of the ridges. Supposing them to be 12 inches asunder, there will just be 30 ribs in every feering of 2 ridges of 15 feet each. Another implement which makes a number of ribs at once is described below.

49. OF SOWING SPRING-WHEAT AND GRASS-SEEDS.

" When winter frosts constrain the field with cold,
The fainty root can take no steady hold."

DRYDEN'S VIRGIL.

(2186.) Wheat cannot be sown in spring in every sort of weather, and upon every variety of soil. Unless soil possesses a certain degree of firmness, that is, contains some clay, it is not considered adapted for the growth of wheat, at least it is more profitable to sow barley upon it; and unless the weather is as dry as to allow strong soil to be ploughed in the proper season, it is also more profitable to defer the wheat, and sow barley in due season. The general climate of a place affects the question of sowing wheat there in spring, and it is a curious problem in climate why wheat sown in autumn should thrive at a place where spring-wheat will not. Elevation of position even in a favourable latitude produces the same effects. Experience in these well known circumstances renders the farmers of Scotland chary of sowing wheat in spring, unless the soil is in excellent condition, and the weather very favourable for the purpose.

(2187.) When wheat is sown in spring, it is usually after turnips, whether these have been entirely stripped from the land, or partly consumed on the ground by sheep. In whichever of these states of the turnip crop may be chosen to be followed by wheat, it is not sufficient merely to raise a crop of turnips by dint of a plentiful supply of manure at one time upon an otherwise exhausted soil, that will ensure a good crop of spring-wheat; the land itself should be and have been for some time, in good heart, otherwise the attempt will inevitably end in disappointment.

(2188.) On a farm possessing the advantages of favourable soil and climate, and on which it is the custom to sow spring wheat every year, the turnip-land is ploughed with that view up to a certain period of the season, not later than the beginning of March; and even on a farm on which spring-wheat can only be sown occasionally, when a favourable field comes in the course of rotation, or the weather proves tempting, the land should be so ploughed as that the advantage may be taken to sow wheat. Should circumstances warrant the attempt, or matters take an unfavourable turn for the purpose, there will be no harm, as the soil can afterwards be worked for barley.

(2189.) Land should only receive one furrow, the seed-furrow, for spring-wheat, for if it is ploughed oftener after a manured green crop, and in spring, when it has become tender by the winter frost, it would want that firmness which is essential for the growth of wheat. The nature of this seed-furrow depends upon circumstances. If the land presents a visible form of ridge, and if it soon becomes wet, the best way to plough it is to gather it up, and then it will have the appearance of being twice gathered up, as in fig. 139. If it is flat, and the subsoil somewhat moist, gathering up from the flat will answer best, as in fig. 133. If the soil has a dry subsoil, though of a pretty strong clay itself, it may be cast with gore-furrows (837.). And should it be fine loam resting on an open bottom, the ridges may be cast together without gore-furrows, as in fig. 135. It is probable that a whole field may not be obtained at once to plough up in either of these ways, and indeed such an event rarely happens in regard to preparing land for spring-wheat; but when it is determined to sow it, a few ridges should be ploughed up as convenience offers, and then a number of acres, sown at one time. In this way a whole field may be got sown by degrees, whereas to wait until the sowing of the whole field at once can be obtained, may prevent the sowing of any part of it in proper season. Nay, bad weather may set in and prevent the sowing after the land has been ploughed; still a favourable week may occur, and at the worst, at the latter end of the season the land may be ribbed with the small plough, in the manner I have described in (2185.), and which will move as much of the tender part of the soil on the surface as sufficiently to bury the seed, and the greater part of the former furrow will still remain in a firm state to support the wheat plant.

(2190.) The land being ploughed, it should be *sown* as quickly as possible; for which purpose the seed-wheat should be measured up in the sacks, or ready to be measured up in the corn-barn or granary, and the means of pickling it also ready when wanted. Wheat should be sown thick in spring, because there is no time for the plant to *stool* or *tiller*, that is, to throw out young shoots from the roots, as in the case of autumnal sown wheat. About 3 bushels per imperial acre will suffice for seed.

(2191.) Seed-wheat should be *pickled*, that is, subjected to a preparation in a certain kind of liquor, before it is sown, in order to ensure it against the attack of a certain disease in the ensuing summer, called *smut*, which renders the crop comparatively worthless. Some farmers affect to laugh at this precaution, as originating in a nonsensical faith in an imaginary specific; but the existence of smut, and its baneful effects upon

the wheat-crop, are no imaginary inventions, and when experience has proved, in numberless instances, that the application of a steep has the effect of warding off the evils of smut, the little trouble which pickling imposes may surely be undertaken, rather than the whole crop be put in jeopardy. *Why* pickling *now* should have the effect of preventing the smut at a *future* period, is a different question; and it is, perhaps, because this question has not hitherto been satisfactorily answered, that pickling is thought lightly of by some farmers, rather than because any valid objection can be urged against its practice. Indeed there cannot, for the palpable fact stands obvious to conviction, that one field sown with pickled wheat, and managed in the usual way, will escape the smut, while an adjoining one, managed in exactly a similar manner, but sown with plain wheat, will be almost destroyed with the disease. I have seen this identical case tried by two neighbouring farmers, the Messrs Fenton, late tenants of Nevay and Eassie, in Forfarshire. It is true, that on some farms wheat sown in a plain state, escapes the disease, as I have heard Mr Oliver, Lochend, near Edinburgh, state is the case with his farm; and it is also true that pickling does not *entirely* prevent the recurrence of the disease on other farms; but such cases are exceptions to the rule, which is, if wheat is not pickled it *may* be smutted; at least no one can aver beforehand that it *shall not* be so; and while uncertainty exists in the recurrence of a serious disease, the *safer* practice is to bestow the trouble of pickling, the expense being very trifling, rather than incur the risk of disease. It is now a well ascertained fact, that inoculation will not insure immunity from small-pox, yet it will certainly modify the attack when it occurs, and so it is with the case of pickling wheat; and as long as means are used to ward off small-pox, so long also, from analogy, ought wheat to be pickled.

(2192.) Wheat is pickled in this way. For some days, say 2 or 3 weeks, let one of the tubs referred to in (1449.) be placed to receive a quantity of chamber ley, and whenever ammonia is felt to be disengaging itself freely from the ley, it is ready for use. It is better that the effluvium be so strong as to smart the eyes, and water added to dilute the liquor, than that the ley be used fresh. This tub should be removed to the straw-barn, as also the wheat to be pickled, and part of the floor swept *clean*, to be ready for the reception of the wheat. Let 2 baskets be provided capable of holding easily about ½ a bushel of wheat each, having handles raised upright on their rims. Pour the wheat into the baskets from the sacks, and dip each basketful of wheat into the tub of ley as far down as completely to cover the wheat, the upright handles of the baskets preventing the hands of the operator

being immersed in the ley. After remaining in the liquor for two or three seconds, lift the basket up to drip the surplus ley again into the tub, and then place it upon two sticks over an empty tub, to drip still more till another basketful is ready to be dripped. Then empty the dripped basket of its wheat on the floor, and as every basketful is emptied, let a person spread by riddling through a barn wheat-riddle, fig. 310, a little slaked caustic lime upon the wheat. Thus basketful after basketful of the wheat is pickled till it is all emptied on the floor, when the pickled and limed heap is turned over and over again till the whole mass appears uniform. The mixing by turning is most surely managed in this way. Let two men be each provided with a barn shovel, fig. 317, and let one stand on each side of the heap, one with his shovel in the right and the other with his in the left hand; let both make their shovels meet in their edges upon the floor, under one end of the heap of wheat, and each, on lifting his shovelful, turn it over behind him, and thus proceed, shovelful after shovelful, to the other end of the heap. Let them return in a similar manner in the opposite direction, and aye till the heap of wheat is completely mixed with the lime and ley. The pickled wheat is then sacked up and carried to the field in carts. Other substances beside chamber ley are used for pickling wheat, such as brine of salt, sufficiently strong to float an egg; solution of blue vitriol—all good enough, I dare say; but when so simple and efficient, and easily obtained an article as ley, can be had, it appears to me unnecessary to employ any thing else. It is a powerful ingredient, destroying vegetable life in the course of a few hours, and it is perhaps to this property that is to be ascribed its efficacy as a protection against the attack of that vegetable enemy of the wheat-crop—the smut. The wheat pickled with it should therefore be used immediately after the process; and as danger may be apprehended to pickled wheat being kept over night, the quantity pickled should be sown at once, and no more should be pickled at one time than can immediately be sown. The use of the quick-lime seems to be to dry the ley quickly, so that the grains may be easily separated from one another in the act of sowing; but there may some chemical change arise between them in the circumstances, which may be serviceable to the purpose for which both are employed. Can it be that the lime fixes the ammonia of the ley, and preserves it for use until wanted by the plant or seed?

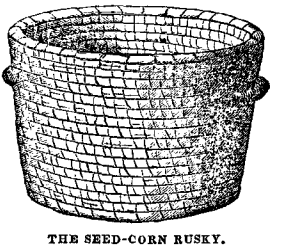
(2193.) There is some art in setting down sacks of seed-corn on the field. It should be ascertained how many ridges of the field to be sown are contained in an acre, so that the sacks may be set down at so many ridges as each sack contains seed to sow the ground, allowing the speci-

fied quantity of seed to the acre. This instruction should be given to the ploughman before he proceeds to the field with the sacks, otherwise he may set them down either too close or too wide. When one row of sacks is sufficient, and the ridges just long enough for the sower to carry as much seed as will bring him back again to the sack, the sacks should be set down in the middle; when the ridges are short, they may be set down on the headridge; and when of such a length as to require two rows of sacks, each row should be set on the same ridges, and the distance between them made to suit the circumstances of the case. The setting down of the sacks should be begun from the side at which the sowing commences, and this again depends on the nature of the surface of the field. If the surface is level, it matters not which side is selected for commencing operations; but if it has an inclination, then that side which lies to the left while looking down, or to the right on looking up, the inclination should be begun to be sown. The reason for this preference is, that *breaking* in the surface with the harrows—that is, the first stroke of them over the ground, along the ridge—is most difficult for the horses to draw; and, to ease their draught, the *breaking should be executed down hill.* The sacks are always placed on the furrow-brow of a ridge, that the hollowness of the open-furrow beside it may give advantage, to the person who carries the seed, to take it out more quickly and easily when it sinks near to the bottom of the sack.

(2194.) The *carrier of the seed* is a field-worker, and the instant the first sack of seed is set down, she proceeds to untie and fold back its mouth, and fill the *rusky*, fig. 371, with seed, and carries the first quantity to the sower, who should be ready sheeted awaiting her arrival on the head-ridge at the side of the field. Her endeavour should be to supply him with such quantities of seed as will bring him in a line with the sack when he wants more; and as the sacks are placed about half-way down the ridges when only one row is wanted, this may easily be arranged; or should there be two rows, she must go from row to row on the same ridge, and endeavour to form the same arrangement. This regular plan will give her the least trouble and supply the sower always with the requisite quantities of seed; and it should be borne in mind that nothing can be more annoying to a sower than to have his sheet brimful at one time, and at another stinted; and it is also very annoying to him to be obliged to wait the arrival of the seed-carrier, whereas she should rather wait on him. If the sacks of seed are conveniently placed, one active seed-carrier will serve two sowers, at *e*, fig. 378; but where the sacks are set down in more than one row, and there are more than one sower, there should be a carrier at each row.

(2195.) The *rusky*, fig. 371, or seed-basket, is usually made of twisted straw laid in rows above each other, and fastened together by means of withes of willow. It is provided with a couple of handles of the same material, sufficient to admit the points of the fingers, and also a rim around the bottom, upon which it stands. In the Border counties, it is carried on the head of the seed-carrier when full, in other parts it is carried in the arms with the bottom rim supported by the haunch. It should be filled each time with just the quantity of seed, and no more, which the sower requires at one time. The mouth of the sack should be rolled round upon itself, that the seed may be easily and quickly taken out, for there is usually no time to lose when seed is sowing. As one sack becomes empty, it should be taken by the carrier to the nearest sack, and as they accumulate, they should be put into one, and thus taken forward out of the way of the harrows. It is not unusual to see the sacks lying upon the ground where they are emptied, and only removed when the harrows come upon them, and not unfrequently tear them, and they are then cast away to be in the road again when the field is harrowed in another direction. The carrier should be careful not to spill the seed upon the ground on taking it out of the sack, otherwise a thick tuft of corn will grow uselessly upon the spot.

Fig. 371.



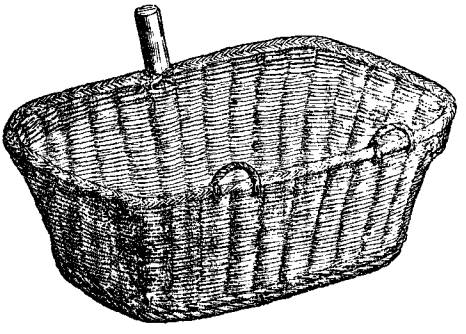
THE SEED-CORN RUSKY.

(2196.) The *sower* is habited in a peculiar manner; he puts on a sowing-sheet. The most convenient form of *sowing-sheet* is that of a semi-spheroid; having an opening at one side of its mouth large enough to allow the head and right arm to pass through, and by which it is suspended over the left shoulder. On distending its mouth with both hands, and on receiving the seed into it, the superfluous portion of the sheet is wound over the left arm and gathered into the left hand, by which it is held tightly, while the load of corn is securely supported by that part of it which passes over the left shoulder across the back and under the right arm. The right arm, which throws the seed, finds easy access to the corn from the comparatively loose side of the mouth of the sheet, between the left hand and the body of the sower. A square sheet, knotted together in three of its corners, and put on in a similar manner, is sometimes used as a sowing sheet; but one formed and sewed of the proper shape, and kept for the purpose, is a much better article. Linen sheeting makes an excellent material for a sowing-sheet, and when washed at the end of the sowing season, will last many years. The

difficult point is to make the sowing-sheet fit the sower on the top of the left shoulder, where the greater part of the weight of the corn is felt, and, in attempting this, the principal thing to be considered is, to make the plain part, which goes over the shoulder, broad enough and to slope with the shape of the shoulder. The gatherings of the cloth on each side of the shoulder-top should be neatly executed, and a couple of tapes drawn tight in a slot-hem in front of the sheet across the breast.

(2197.) A *basket* of wicker-work, such as in fig. 377, is very commonly used in England for sowing seed. It is suspended by girthing,

Fig. 377.



THE ENGLISH SOWING BASKET.

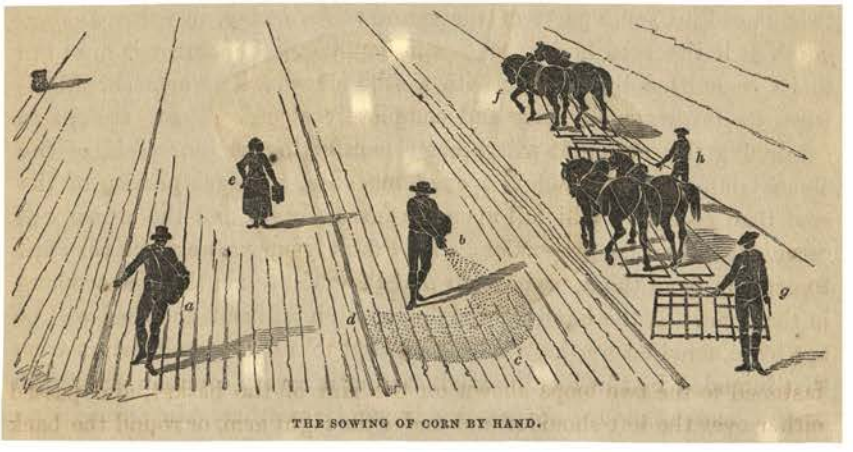
fastened to the two loops shewn on the rim of the basket, and passed either over the left shoulder and under the right arm, or round the back of the neck; and the left hand holds it steady by the head of the wooden stave shewn on the other side of the basket. No doubt such an instrument answers the purpose of the sower, or it would not have been so long in use, but, for my part, I much prefer the comfortable feel of the linen sheet to the hard rubbing of the willow basket.

(2198.) Both these forms of utensils for sowing seed are intended for the use of one hand only, but some sowers throw the seed with both hands, and then the instrument must be made to suit the practice. In this case, a linen sheet will not answer, a basket or box made of thin deal, having a curved form to suit the front of the body, should be used. It is fastened round the body by a strap and buckle, and is suspended besides by girthing fastened to loops on the side next the sower, and passed round the back of his neck; and the further side is suspended by a strap passing upwards towards the chin of the sower, where it divides into two, and passes over both shoulders, and is made fast to the strap buckled round the body. A more simple form of sowing-sheet for both hands, is a linen bag attached to a hoop of wood or iron-rod, made to

suit the form of the body, buckled round it, and suspended in front in the manner just described. Both hands are thus at liberty to cast the seed.

(2199.) In sowing with one hand, the sower walks on the third and fourth furrow-slices from the open-furrow, which he keeps on his right hand. Taking always as much seed as he can grasp in his right hand, he stretches his arm out and back, with the clenched fingers looking forward, while the left foot is making an advance of a moderate step, as represented by *a*, fig. 378. When the arm has attained this position,

Fig. 378.



THE SOWING OF CORN BY HAND.

the seed is begun to be cast, which is done with a quick and forcible thrust of the hand forward. At the first instant of the forward motion the fore-finger and thumb are a little relaxed, by which some of the seed drops upon the furrow-brow and in the open-furrow, and while relaxing the fingers gradually, the back of the hand is turning upwards till the arm is stretched forward, when the fingers are all thrown open, with the back of the hand uppermost. The forward motion of the hand is accompanied by a corresponding forward advance of the right foot, which is planted on the ground the moment the hand has cast forward the most of the seed. This position is attempted to be represented by the figure at *b*. The figure which the seed describes on the ground, in being thus cast forward is something like the area of a section of the extreme end of the larger axis of a very excentric ellipse, having one corner of the section at the open-furrow, and the other stretching 2 or 3 feet beyond the crown of the ridge, and its broadest part spread over that side of the ridge on which the sower walks: this figure is

attempted to be shewn by *b c d*. The moment the seed is got quit of, the hand is brought back to the sowing sheet, and thence replenished, is stretched back for a fresh cast, while the left foot is made to advance simultaneously. Thus the right hand and right foot play into each other with a regular *simultaneous* motion, while the same hand and the left foot play with an *alternate* motion.

(2200.) Many points require consideration to enable the sower to cast the seed *equally over the ground*. If the hand and feet do not correspond in their motions, the ground will not be equally covered, but a strip between the casts left almost bare. When the braird comes up, the omission shews itself like the steps of a ladder, and hence it is named, in some parts of the country, *laddering*, in other *happer-gain'*, as if the seed had been cast in hopping. This error is most apt to be committed by a sower with a stiff elbow. The arm should always be thrown well back and completely stretched out, though in continuing this action it will become painful in the inner fold of the elbow joint. If the hand is opened too soon, a larger portion of the seed than necessary will fall upon the furrow-brow, and the crown will receive less than its proportion. This fault young sowers are very apt to commit, from the apprehension that they will retain the seed too long in the hand. If the hand is brought too high in front, the seed will be apt to be acted on by the wind, and tossed to a different direction from that intended by the hand. High casting is a very common error with sowers, and is an unsafe practice in windy weather. In strong wind the sower is sometimes obliged to walk on the adjoining ridge to the windward, to sow the one he wishes; and a sower who casts high will never make good work in such a case. In casting high, the hand is sure to be elevated above the level of the elbow, whereas it should always be below it. The hand should be kept low, the arm stretched out, and the seed made to fly in a curve in front, by a sharp turn of the hand, and a free opening of the fingers near the end of the action, the nearest edge of the cast falling within two paces of the sower. Seed, when so cast, will be little affected by even a strong wind. Some sowers take long steps, and fill their hand with the seed as if in a shovel, and of course make long casts, reaching across the ridge from open-furrow to open-furrow. Such a sower will spill the seed behind the hand, and make bad work in wind. The step should be short, the casts frequent, and the seed held firmly in the hand, when a complete command of the whole work will be obtained.

(2201.) A sower with both hands must make high casts, otherwise the seed will not reach the furrows as he walks along the crown of the

ridge, which he must do. I can see no advantage attending this mode of sowing over the other, but, on the contrary, a considerable risk of scattering the seed unequally, for however dexterous an ambi-dexter sower may become, his left arm will not make so perfect a cast as his right, if he is a right-handed person. In calm weather he may get on tolerably well, as also with the wind direct in his face or in his back; but a side-wind would puzzle him, for while adjusting himself to it for one of the hands, the other is immediately placed in a disadvantageous position. In short, he should not sow with both hands in wind. An Irish sower usually makes a step, stands still, and scatters one handful of seed with two short and one long cast of the arm. This is slow work.

(2202.) A single-handed sower makes a bout to sow a ridge. When the ridge is single, fig. 133, he always keeps the open-furrow on his right hand; when it is double, that is, cast together, fig. 135, he must go a bout round the crown, as well as by the open furrows; and where the land is ploughed two-out-and-two-in, fig. 138, a mark of some sort will be required to keep him in the proper place between the crown and open-furrows.

(2203.) It is obvious that in sowing with the hand, the corn is scattered promiscuously, and, in whatever arrangement it may come up, depends on the form of the ground, whether it had been ploughed in common furrows or in ribs; for, in the latter case, the corn comes up in rows or drills, the corn having fallen into the hollows of the ribs when sown; and in the former, broadcast, that is, equally over the surface of the ground.

(2204.) Pickled wheat annoys the sower, the caustic lime acting upon the skin of the sowing hand, and shrivelling it. It also rises in impalpable dust, and adheres to the eyelids and lips, and even sticks upon the face when in a state of perspiration. It is scarcely possible to avoid this annoyance, especially when a breath of wind blows on the back, when the face is almost smothered in an eddy. To prevent future bad consequences of the lime, the hands and face should first be washed with milk, and the milk then washed clean off with warm water and soap, and, lastly, the eyes, lips, and back of the hand, anointed with cream or butter.

(2205.) The *harrows* follow the sowers, each sower keeping 2 pair of harrows employed when the land receives a *double tine*, that is, backwards and forwards on the same ground, which a *breaking in of the seed* should always be. I have already said, that, on inclined ground, for the sake of the horses, that end of the field should be first sown which gives the horses the advantage of breaking the seed down hill (2193.). If the sowing commences at the top of the declination, the harrows

start at once for the breaking in down the hill; but if it commences at the foot of the inclination, the harrows will have to go to the upper side of the field and begin there. Two pairs of harrows work best together, their united breadth covering the entire ridge, and lapping over the crown where the soil is thickest (2153.). One pair takes the lead, *f*, fig. 378, that is, goes on one side of the ridge, while the other, *g*, follows on the other side. The leader usually takes that side of the ridge which is nearest the open field. Each pair of harrows should be provided with double reins, one from each horse; and every ploughman should be made to walk behind the harrows, and drive his horses with the reins, as at *g* and *h*. If a strict injunction is not laid on them in this respect, the two men will be found walking together, the leading one behind the harrows, the other at the head of his horses, with their attention more engrossed in conversation than the work in hand. Indeed, in some parts of the country, the ploughman who drives the hindmost pair of harrows does not think it requisite to employ reins at all, so sure is he of leading his horses by the head; and the leader, to give himself less trouble than by the voice, takes a single rein with him, by which he guides the near horse. It is the constant use of the single rein which renders horses, in parts of the country where it is most in use, more easily *hied* than *hupped*. The double rein, on the other hand, enables the ploughman to *hup* his horses with ease; though, no doubt the horses will turn more naturally towards their driver than away from him. To draw harrows as they should be drawn, is not so light a work for horses as in appearance it is; and, indeed, when the tines are new sharped and long, and take a deep hold of the ground, the labour is considerable. To harrow the ground well, that is, to stir the soil over the seed, and bring to the surface and pulverize all the larger clods, requires the horses to go at a smart pace; and indeed harrows should always be employed with a quick motion. If the men owe the steward a grudge for his sharp discipline, spring-wheat sowing is a favourable time to take advantage of him, when the land is naturally friable and easily pulverized, and the horses are quite fresh, and when, on the other hand, the lime of the pickle annoys the sower's face, and the land is rather soft for quick walking. If they keep the harrows hard at his heels, for very shame he must sow hard to keep out before them; and if he is a slow sower, he must get a good heating. I never see a man sowing with his coat on below the sowing-sheet, than a wish arises to see the harrows close at his heels to punish him for the lazy-looking trick.

(2206.) In conducting the harrowing after the seed, the mode must

be guided by the circumstances of the case. If the harrows commence at the foot of the inclination, the ridge next the fence should be ascended, and the second ridge descended, to break in the seed; and *hieing* the horses at the foot, the first ridge is again ascended, which finishes its double tine; and though both tines have been given on it in the same direction, the anomaly should be submitted to, in order to gain a favourable point for the horses to start from to break in the seed. *Hieing* the horses again on the upper head-ridge, the third ridge is broke in; and hieing again on the lower head-ridge, the second ridge is ascended, and is thus finished of its double tine. Thus by hieing both pairs of harrows at both ends, one ridge is broke in in going down, and another receives the double tine on coming up, and this is a simple and easy mode of working the horses: but suppose the harrowing had been begun at the top of the declivity, the breaking in will then commence at once on going down hill, and to preserve this advantage, the harrows should come up the same ridge and finish it with a double tine, and so on with every succeeding ridge. As there is little room for 2 pairs of harrows to turn at the end of one and the same ridge, the leading harrows are driven straight forward upon the head-ridge, and the horses are *hied* so as to make them move round upon the far side of the head-ridge, and still *hied* round, they take up their place on the same side of the ridge they had come down; while the hind harrows are *hupped* so far at the end of the ridge as to leave room to turn upon the far side of the head-ridge, and then *hieing*, take up their position on the same side of the ridge they had come down, after the leading harrows had passed to their position, and are moving onwards. The entire movement is easily managed with double reins; but with a single rein, or with the voice alone, this mode of turning is apt to create confusion. If the inclined field is begun to be sown at the opposite side it should be for easy breaking in of the seed for the horses, and whether the harrowing is begun at the foot or top of the inclination, the same arrangement as I have described can be followed; but in following it here the horses will have to be *hupped* instead of *hied*. I have recommended the *hieing* because it is more easy for the horses, they being more accustomed to it; but instead of always *hupping*, which this mode imposes, there is a plan of avoiding the inconvenience, and it is this. A break of 6 ridges are taken, and the harrowing of them is begun on the last sown ridge, and continued over them in the same manner as if it had been begun at the proper side of the field, the only difference being that in this case the harrowing is conducted in the opposite direction to that in which the

sowers are proceeding. When one break is finished, another is taken in, and so on until the field has been all broken in.

(2207.) After the appointed piece of ground, whether a whole field or part of one, has been sown and broken in, the land is cross-harrowed a double tine, but as, in this, the ground is not confined within the breadths of ridges, the harrows cover as much of the ground as they can, and get over it in less time than in breaking in; and, besides, the second harrowing being easier for the horses, they can walk faster.

(2208.) In regard to harrowing ribbed land, a double tine of breaking in is all that it receives to place it in the same position as the common mode of seed-furrowing is placed after the cross-harrowing—ribbed land never being cross-harrowed, as that would derange the drilled-like state of the seed, and bring a large proportion of it again to the surface.

(2209.) To judge of the harrowing of land, the sense of feeling is required as well as that of sight. When well done, the friable portion of the soil seems uniformly smooth, and any clods that are seen should lie free upon the surface. The ground, too, should feel uniformly soft under foot. When the land is not enough harrowed, the surface appears rough, and the clods are still half immersed in the soil, and the ground feels unequally soft under foot, in some parts resisting pressure, in others giving way too easily.

(2210.) The well-harrowing of land is a point of more importance than seems generally to be imagined. Its object is not merely to cover the seed, but to pulverize the ground, and render it of a uniform texture. Uniformity of texture keeps the soil in a more equal state of temperature, not absorbing rain so fast, nor admitting drought so easily, as when the soil is rough and the clods keeping it open. Whenever the texture is made uniform, the harrowing should cease, for it is a fact, especially in light, soft soils, that more harrowing than necessary brings part of the seed up again to the surface.

(2211.) Spring-wheat following a green crop is always sown down with grass-seeds, and the land is in a fit state to receive them when it is in the above condition of its harrowing; but as grass-seeds are also sown at this time amongst the wheat that was sown in autumn, it is requisite to consider, in the first place, the state of that crop before proceeding to sow them among the spring-wheat, especially when both kinds of crop are in the same field. The state of the *winter-wheat* depends entirely on the sort of weather it had to encounter in winter and early spring. If the winter has been open and mild, the autumn-wheat plant

will have grown luxuriantly, indeed so much so, that it may have become *proud*, that is, in a precocious state of forwardness for the season. When it is in this state in spring, which is rarely the case in Scotland, though not unfrequent in England, a heavy fall of snow in spring, that happens to lie for some weeks, will rot a great many of the plants; and, instead of the rest retaining their green colour under the snow, they will become blanched at the roots, pressed flat to the ground, and will probably never rise again. Blanks will in consequence be formed where this catastrophe has happened; but unless these be of large extent, or the season be far advanced before the wheat has been liberated from its snowy covering, the plants will tiller out with new runners from the roots of the surviving old plants, and occupy the blank spaces. When snow falls upon wheat in the early part of winter, and covers it for a considerable time, it protects the crop from injury from the atmosphere, and prevents the earth from cooling below 40° Fahr. In this position the young plant retains its healthy green colour, though it does not grow much; and whenever it is relieved from the snow, it grows rapidly, unless it happens to encounter black frost, which changes its greenness into a brown, and may kill some of the plants; but should there be no black frost, there is no state of the young wheat plant in spring in which it tillers so closely, and afterwards grows so equally, as after emerging in favourable circumstances from snow. The most trying time, however, for winter wheat is in March, when sharp frosts frequently occur at night, and bright sunshine in the day. The frost draws the moisture of the ground to the surface, and there freezes it; when the sun shines upon the ice it melts, and most frequently very rapidly, and the consequent evaporation produces such an intense degree of cold as even to kill the plants suddenly; and if they escape destruction in this way, the damp ground that had been raised up by means of the expanded condition of the ice suddenly contracts by its melting, leaving the plants with their roots half drawn out of the earth, in which state many perish. It must be owned, however, that this particular effect is most commonly produced on loamy soils which rest on impervious clay subsoil and not on a dry subsoil, so that draining may be reasonably expected to prevent this injury. Continued rains upon winter wheat make it change its colour to a bluish hue, and if the air is temperate, the plant becomes tender, and at length sets up with red-pointed leaves, as if it would grow no more. Continued drought in spring, on the other hand, makes winter wheat of a vivid green, especially in fresh weather; but should it be cold and inclined to frost, the points of the leaves become brown, which latter effect is invariably induced by the cold east winds so pre-

valent in spring in this country. Drought and heat combined always promote the vigour of the wheat plant.

(2212.) Although I have said that double harrowing across prepares the land on which spring-wheat has been sown for grass-seeds, it should not be imagined these are sown whenever wheat-seed is sown, because the latter may be sown at any time during winter or early spring that the state of the weather and soil will allow; but when spring-wheat is sown at the latest period of the season, then grass-seeds may not only be sown amongst this, but amongst all the spring-wheat that had been previously sown; and at the same time amongst the winter-wheat, if the land that has stood all winter is dry enough to bear harrowing at the time. Frost injures clover-seeds, and will even kill them when exposed to it, so that they cannot safely be sown very early in the season; but there is not much risk of frost being so powerful in March as to injure seed that is harrowed in. Many farmers used to sow grass-seeds without harrowing, trusting to so small seeds finding their way into the soil amongst the clods, and of being covered by their mouldering, and this practice is, I believe, not yet relinquished; but the safer and more correct practice is to cover every kind of seed when it is sown by harrowing. It may happen, that in the same field in which the latest spring-wheat has been sown, may be found some that had been sown at a former period, and even winter-wheat may occupy another part of it. When this is the case, and especially if the last sown completes the cropping of the field, then the grass-seeds should be sown over the whole field at one time, beginning with that part which has just been sown, continuing it over that which was the next last, and finishing upon the winter wheat; because it is desirable first to finish the land that has been most recently worked, in case the weather should change, and prevent the finishing of the whole field. Should barley, however, have still to be sown on that field, it will be better to defer the sowing of the grass-seeds upon the wheat until the whole field is sown at one time; and in this case the new-sown spring wheat can be water-furrowed, and put past danger for the time. If the winter-wheat in the same field is, on the other hand, far advanced, and the weather still favourable to its growth, the grass-seeds should be sown amongst *it*, for, if delayed too long amongst strong plants, part of the seed may not find its way to the soil, and the subsequent harrowing may injure the progress of the already forward plant. In such a case the spring-wheat should be sown with the grass-seeds at the same time, and the barley-land can be sown by itself, when the barley-seed is finishing.

(2213.) The seeds usually sown amongst grain-crops for the future grass-crop consist usually of three kinds; annual red clover (*Trifo-*

lium pratense), white or Dutch clover (*Trifolium repens*), and ryegrass (*Lolium perenne*), and some farmers sow a portion of yellow clover (*Medicago lupulina*), but for what good property it possesses I cannot say, unless for its cheapness in comparison with other clovers, namely, from 22s. to 28s. per cwt., which I suspect is the true cause of the demand for it. It is a worthless plant, in my estimation, having a wiry stem difficult to cut with the scythe as a forage plant, and disagreeable to crop as a pasture one. The proportions in which these seeds are sown depends on the rotation followed. If the grass is to continue in the ground only 1 year, a larger proportion of red clover is used than when it is to continue for 2 or more years. It is considered that 12 lb. of clover seeds, and 1 bushel of ryegrass, is sufficient for an imperial acre. If the grass is to continue 1 year, the ryegrass should be the *annual*, and so called because it only affords a crop for 1 year, though by that time it has been 2 years in the ground—1 with the crop in which it was sown, and 1 with the clover-seeds,—and though there is no botanical distinction between it and the true perennial ryegrass. This seed weighs 30 lb. per bushel, gives 1712 grains to 1 drachm weight, and costs, by the quotations of 1843, from 20s. to 28s. per quarter. For the same duration of the grass crop, 10 lb. of red clover, and 2 lb. of white, should be sown on the acre. The red clover weighs 64 lb. per bushel, and gives 2000 grains to 1 drachm, and the cost is from 56s. to 75s. per cwt. The white clover weighs 65 lb. per bushel, and though so heavy a seed, it is so small, that it takes 4000 grains to weigh 1 drachm, and its usual cost is from 56s. to 75s. per cwt. When the grass is to remain more than 1 year, 6 lb. of red, and 6 lb. of white, and 1 bushel of true perennial ryegrass, are considered good proportions. The perennial ryegrass weighs 18 lb. per bushel, gives 2000 grains to 1 drachm, and its cost usually is from 24s. to 48s. per quarter. I have mentioned the sowing of ryegrass per bushel, which is the usual mode of estimating the quantity of this seed; but it should be sown by weight as clover is, as the most satisfactory mode of bestowing on the land its desired quantity of genuine seed.

(2214.) Of late years, other seeds have been recommended to be sown alongst with these, to suit the purposes for which the grass is intended. Among these is the Italian ryegrass (*Lolium Italicum*), which, possessing the valuable properties of celerity of growth and sweetness of taste, is well deserving of cultivation; but its remarkable quickness of growth renders it doubtful, desirable as the plant is, to sow amongst grain. Their great disparity between their relative periods of growth, and also that of the other seeds usually sown with the grains, indicate that its culture should be confined to itself. It would seem to class itself rather among

the true forage plants, such as tares and rape, than the true hay and pasture plants, as at present cultivated. In as far as 1 year's grass is concerned, there does not appear much room for improvement in the proportion of the seeds sown for the purpose; but in the case of pasture of more than 1 year's standing, for which only the perennial ryegrass and white clover are sown, excellent as these certainly are in themselves, a greater variety of seeds might be introduced with advantage. On this subject Mr Lawson makes these judicious and well-founded suggestions. "For 3 years' pasture on good soils," he says, "the substitution of 2 lb. of *Dactylis glomerata*, the common rough cock's-foot, for about 3 lb. of the perennial ryegrass, will be found advantageous; while in sheep pastures the addition of 1 lb. per acre of parsley-seed (*Petroselinum sativum*) would also be attended with good results; and in certain upland districts, established practice will point out the introduction of 2 lb. or 3 lb. of rib-grass (*Plantago lanceolata*). In proportion to the retentiveness of heavy soils, as well as for those of a peaty nature, *Phleum pratense*, the meadow cat's-tail, should be added, to the extent of 2½ lb. to 3½ lb. per acre."* The improvement of pastures of 2 or more years' standing, not permanent pastures, has received less attention from farmers than it deserves. Had Italian ryegrass been more of a perennial than it is, it would have formed a valuable ingredient in such pastures, both for sheep and cattle. Sheep are remarkably fond of parsley, and will not allow it to run to seed.

(2215.) The mode of *mixing ryegrass and clover seeds* is this. The ryegrass seed is laid in a heap on the corn-barn floor, and the heap is made as flat on the top as to contain the clover seeds to be mixed with it. The red clover, being the larger sized seed, is put on first, and spread over the top of the ryegrass; and then the white clover is poured over the red. The entire heap is then turned over in the same manner as described for pickling wheat (2192.), by two barn-shovels, fig. 317, being made to meet under the heap, and turned over behind the operator. This is done as often till the seeds, on being examined, appear well mixed. Although the clover seed is so much heavier than the ryegrass, it does not fall to the bottom of the heap, on account of its smallness, which enables it to lie in the bosom of the ryegrass seed. The mixture is put into sacks, and taken to, and set down upon, the head-ridge of the ground sown with spring-wheat.

(2216.) The sowing of grass-seeds by hand is a simple process, though it requires activity to do it well. Being sheeted as before (2196.) or

* Lawson on the Cultivated Grasses, p. 53.

(2197.), and provided with a carrier of the seed (2194.), the sower grasps the mixed seeds with two fingers and the thumb, instead of the whole hand, and makes the cast and steps exactly in the same manner as described in sowing corn (2199.). Clover and ryegrass seeds being so very different in their form and weight, it is not possible to cast them from the hand so that both shall alight on the ground in the same manner. The sower, in fact, has little control over the ryegrass seed, the least breath of wind making it go wherever it may. His object simply is to cast the heavy clover seed equally over the surface, and, as it cannot easily be seen to alight on the ground, it is the more necessary that he preserve the strictest regularity in his motions. In windy weather, the small heavy clover-seed can still be cast with pretty tolerable precision, at least as much so as corn, and the ryegrass must just go where it may. Some sowers attempt to sow a ridge with 2 casts, taking a larger handful of grass-seeds; but the surer plan is to take the smaller quantity in the two fingers and thumb, and give the ridge 3 casts, one along each furrow-brow, and the third along the crown. It is pleasant work to sow grass-seeds by the hand. The load is comparatively light, and the ground having been harrowed fine, and perhaps even rolled, the walking is easy; and although it may be somewhat tiresome to go over the same ridge 3 times, the quick step in which the labour may be performed dispels irksomeness; and this is especially the case when 3 sowers work together, 2 making 2 casts along the furrow-brow of their respective ridges, and the third following one of the sowers down the crown of one ridge, and coming up behind the other on the crown of the other ridge. On making one of a party of three, who, in sowing, in one day, 72 acres imperial (24 acres to each), with 3 casts to every ridge of 15 feet in width, I believe I did as great a day's work in this business, as most people ever did. It was done in Berwickshire in 1817, before the grass-seed sowing-machine was used by Scotch farmers; and in doing it each of us walked 40 miles in 10 hours.

(2217.) But such feats cannot now be performed, because the grass-seed sowing-machine supersedes the necessity of attempting it. It is a most perfect instrument for the sowing of grass-seeds, distributing the seeds with the utmost precision, and to any amount, and scattering them so near the ground as to render their sowing a matter independent of windy weather. This machine will be found figured in Plate XXVI, fig. 372, and a detailed description of it by Mr Slight will be found below. Its management is easy, when the ground is ploughed in individual ridges; the horse which draws it walking in the open furrow, as in *a*, fig. 133, and the machine reaching in length to the crown of the ridge

on each side, to *b* and *b*, sows the width of a ridge at once, the length of the machine being made to suit the breadth of the ridges adopted on the farm. The gearing is put out of action till the horse enters the open furrow from the head-ridge, when it is put on, and it is again taken off when the machine reaches the opposite head-ridge. The seed is supplied at one of the head-ridges, and the head-ridges are sown by themselves. When ridges are coupled together, the horse walks down in the middle between the crown and the open furrow, taking the furrow-brow as a guide for the line he should keep. Where ridges are ploughed in breaks, as two-out-and-two-in, fig. 138, it is necessary to use some marks on the spaces of the ridges between the crown and open furrows, to guide the line of the machine. The driver ought to be provided with double-reins. Were this machine to proceed onwards, sowing without interruption for 10 hours at the rate of 2½ miles per hour, it would sow 54 acres of ground; but, of course, the turnings at the landings, and the time spent in filling the machine occasionally with seed, cause a considerable deduction from that quantity. The machine is also used to sow corn in broadcast, and it answers the purpose very well, but not perhaps in so superior a manner to the hand as it does the grass-seeds, nor is it so generally employed to sow corn as grass-seeds, but for what reason I cannot say. There was a reason for this before the introduction of the third or front wheel, the weight of the box when full of corn being too heavy for the horse's back, especially in going down hill. I cannot refrain from pointing out the superior construction of this machine, as represented in Plate XXVI, in putting it in the power of the person who drives it to contract its length, so as to admit the machine easily into a field-gate, and thereby to dispense removing it, at any time, from its carriage.

(2218.) After the grass-seeds are sown, the ground is harrowed to cover them in; and for this purpose lighter harrows are used than those for ordinary harrowing; and being light, are not unfrequently provided with wings, to cover a whole ridge at a time, so that in following the sowing-machine, the process connected with the grass-seed sowing may be finished at once. There is some dexterity required in driving winged grass-seed harrows. It is not convenient to move them from one ridge to another immediately adjoining, as a part of the implement will have to turn almost upon a pivot; in doing which, unless conducted with great care injury is apt to be done to it. And, besides, it is a particularly awkward movement to *hup* the horses with these harrows. The plan to avoid the inconvenience alluded to, is to *hie* the horses at the end of all the landings, and leave an intermediate unharrowed ridge at

every turning, which will be greatly facilitated if the ploughman lifts up the near wing from the ground with a hooked stick when the turning is to commence, and lets it drop down again when it is finished.

(2219.) The land may be rolled or not, according to circumstances, before the grass-seeds are sown. If it is dry, even strong land would be the better, at this season, to be rolled, to reduce the clods before they become very hard, and to form a kindlier bed for the small seeds. Should it, however, be in a waxy state, between the wet and the dry, the rolling had better be deferred till afterwards. When it is in a proper state for rolling at the time of sowing the grass-seeds, it should be rolled before the sowing, and, of course, before the harrowing of the grass-seeds; because, were the land left with the smooth rolled surface, and rain come after, and this succeeded by drought, which is not an unfrequent state of the weather at this season, the smooth ground would become so battered and hardened, as to curb the wheat braird considerably; whereas, were it rolled before it was sown, and then harrowed, the harrowing would again raise a small round clod, which would prevent the battering by rain, and consequent encrustation of the land, while the smoothed ground would offer a fine surface for the small grass-seeds to spread themselves upon. On lighter soils, such as hazel loams and turnip soils, it is better not to roll until the land has been sown and harrowed, because the smooth rolled surface assists in repelling the drought for a considerable time, and rain cannot injure such a soil in any way.

(2220.) The roller is represented below, where it is particularly described by Mr Slight in its principles and action. It is most conveniently formed of cast-iron, and in two pieces, and mounted with shafts and framing. The cast-iron gives weight, which a roller should always have, and, being in two pieces, gives a facility to turn on little space. In driving it, the ploughman may sit on the front of the framing, if he wishes, and urge the horses with whip and reins. The framing sometimes supports a box, into which stones are placed to render the roller heavier, and this device may be necessary when reducing hard clods of clay, in summer. Whether used for this purpose or not, the box is useful in carrying any stones that may be found on the land to either side of the field. It has often seemed to me ridiculous to see a small stone roller, or one lightly constructed of wood, used to crush clods on new ploughed heavy land. Instead of breaking them, a light roller only presses them into the softer soil upon which they are lying. The roller is found to do its work in the best manner when drawn *across* the ridges, at right angles to the open-furrows, which are thus easily passed over.

Feerings should be set off when land is about to be rolled; and those of 30 yards in width, as for cross-ploughing, answer well (2156.). It is not necessary to use poles for setting off these feerings, the breadth being paced off by the step, and clods set up for marks upon the land. The first part of each feering is gone round by *hieing* the horses, and the two adjoining feerings are closed in by *hupping* them. Were a 6-feet roller to proceed uninterruptedly for 10 hours, at the rate of 2½ miles per hour, it would roll about 18 acres a-day; but what with the time spent in the turnings and the markings off of feerings, 14 acres a-day may be considered a good day's work. When the weather is favourable, and a large extent of ground has to be rolled, it is a good plan to appoint 2 pair of horses to work the roller, from dawn to night-fall, each pair working 4 hours at a time. In this way, 16 hours' rolling, from 4 in the morning to 8 at night, may be obtained in the course of 24 hours.

(2221.) The finishing process consists of *water-furrowing*, that is, making a plough-furrow in the open-furrows, for the purpose of affording facilities to rain-water to flow off the surface of the land. It is executed with a common plough and one horse, or with a small double mould-board plough and one horse; and in the execution, the plough obliterates the horse's foot-marks. When the land is harrowed after the rolling, as in the case of heavy land, the water-furrowing is done after the harrowing, and finishes the work of the field; but when rolling is the finishing operation, as in the case of light soils, the water-furrowing is executed immediately after the harrowing and before the rolling. Water-furrowing *after* rolling gives a very harsh looking finish to a field.

(2222.) There is a method of sowing spring-wheat very different from any I have yet mentioned, namely, after grass, and of course grass-seeds cannot be sown with it. In this position spring-wheat takes the place of oats. It is rather an unusual operation to sow wheat after grass in Scotland, though the practice is common in England, and its success attests the superiority of the English climate. But there are other circumstances which promote the culture of spring-wheat in England, after grass, instead of oats; the first of which is, that the climate is too dry, and perhaps also too warm, in the southern counties, for the perfect growth of the oat; and the second is, that oatmeal does not constitute the food of any portion of the English people. The very opposite of these circumstances have operated to encourage and maintain the culture of oats in Scotland. The climate is somewhat humid, which is congenial to the growth of the oat plant, and it is not so warm, even in summer, as to stint its perfect development, while oatmeal has long been a favourite food with the labouring people. Now, however, that wheat

bread is becoming a necessary article of food with many of the labouring population, it is worth consideration whether more wheat and less oats than hitherto should not be raised in Scotland; and the only way of substituting the one crop for the other is by sowing wheat on lea-ground in spring. I have said, it is not in every season that spring-wheat ripens in this country (2186.), but this remark referred only to its culture after turnips, instead of barley; and it may prove to be a fact that wheat will thrive better after grass than after turnips. Its culture after turnips has long been tried, and experience rather dissuades from its extension; and as that after grass is but of recent date, experience cannot yet guide the Scottish farmer in the matter. The chief obstacle to sowing wheat in spring is the peculiar effect of the two principal classes of soil on the growth of that plant. Clay soils are too inert in this climate to mature the growth of wheat in a few months; and lighter soils, though more promotive of quick vegetation, are too loose to support the plant with a sufficient degree of firmness to allow it to derive advantage from the manure applied to the soil, and too easily affected by the frequent recurrence of severe drought in early spring. Any means that can be devised to consolidate the lighter soils, so as they may, at the same time, repel inordinate drought and support the wheat plant until it has nearly gained maturity, is a desideratum; and from the experience hitherto gained of its efficacy, it would appear that the use of the *presser-roller* will effect these objects.

(2223.) This implement is seen below, where Mr Slight's description of it will be found. Like the best of our agricultural implements, it is of English origin, where it has long been employed to compress light soils. It is used in this manner in compressing the soil. Driven by one horse, it follows the last of 2 ploughs, after they have laid over their furrow-slices; and on passing along these two furrow-slices, not only compresses them into less bulk, but leaves a groove on each of them to receive the seed when the land is sown. With 1 presser, 2 acres of ground can only thus be compressed in the course of a day; and, where a considerable extent of spring-wheat may be sown, this rate of sowing would be too slow. Either the number of pressers should be increased, or a considerable extent of land be pressed before it is sown; for it would be tiresome work to sow only 2 acres a-day of a large field, which might require a fortnight of 2 ploughs to plough. Perhaps the most convenient plan for most farmers would be to have 2 pressers in operation, and sow the ground compressed every two days, that is, 8 acres, which would be a large enough sowing of spring-wheat in one day upon a farm that worked 4 pairs of horses; and this plan may be

followed, with perfect safety to the wheat crop, for a double tine along of the harrows is quite sufficient to cover pressed spring-wheat; and, indeed, it should receive no more, unless perhaps a single tine along, in case the surface is considered not sufficiently fine, for cross-harrowing would discompose the seed that had fallen in rows into the grooves made by the pressers. Another plan is to plough and press the lea early in winter, allow it to consolidate still more, and then sow an entire field with wheat in spring, if the weather be favourable, and if not, it will be ready for oats. This, I conceive, would be an excellent plan to follow on light soils, that are in a rich enough state for spring-wheat.

(2224.) This same instrument may be beneficially employed in compressing light turnip-land as it is ploughed into ridges, and rendering it more fit for spring-wheat; and in effecting this purpose it is employed in the same manner as on lea.

(2225.) But the presser may be employed on even strong lea, and the crop of wheat consequent thereon increased to a sensible degree, as the following case will testify:—"A very striking instance of the utility of this machine," says Mr Hugh Watson, a gentleman whose name is well known in this country as an eminent farmer, "was exhibited on a field belonging to my friend Captain Barclay Allardyce of Ury, who last season (1832) broke up a piece of grass land near his mansion-house, supposed to have lain out about 100 years. It was a strong soil, and required 4 horses to work the plough, and it was followed by the presser, leaving the work in such a finished state, that although Captain Barclay's intention was to sow the field with oats, after the preparation of a winter's exposure, he was induced to try a crop of wheat, and succeeded beyond his expectation, having reaped 50 bushels per imperial acre, while the probability is, that if the field had been sown in spring with oats, they would all have rotted." "I have used the presser," continues Mr Watson, "for two seasons, and can with confidence recommend it *on all light soils with every sort of corn crop.*"* It would thus appear that the use of the presser is almost of general application, and that the ground may be ploughed a considerable time before it is sown, which renders it of use even on a winter furrow. Several farmers in Forfar and Fife shires, I am aware, have used this instrument for several years, but I have not learned with what success.

(2226.) With regard to the varieties of wheat which you should sow in spring in preference to others, is a subject in which I feel I cannot advise with confidence. The erroneous classification of wheat by

* Quarterly Journal of Agriculture, vol. iv. p. 545.

botanists, in as far as it affects agriculture, into beardless or winter and bearded or spring-wheat, is apt to mislead the farmer; and were he so far to rely on the opinions of botanists as to try these two distinctions of wheat in the season said to be suitable to each, he would certainly be disappointed, for the results would probably be the very opposite anticipated. For this reason I quite agree with Mr Lawson in what he has said on the subject. "Botanists," he states, "generally divide the common beardless and bearded wheats into two distinct species, terming the former *Triticum hybernum*, or winter-wheat, and the latter *Triticum æstivum*, or summer-wheat. But the propriety of the distinction may well be questioned, more particularly as the chief distinguishing character between them consists in the varieties of the former being beardless, or nearly so, while the awns of the latter are generally 2, 3, or more inches in length; and it being an established fact, that the awns or beards in grasses form by no means a permanent specific distinction, and that in many cases they do not even constitute a variety, so much does their presence or absence depend upon the effects of climate, culture, soil, &c. . . . . But the principal objection to the names commonly used is, that they make no proper distinction between the two great classes—*winter* and *spring* wheats; for instance, under *Triticum hybernum* are included several of the earlier, and, without doubt, the best sorts of spring-wheat; and under *Triticum æstivum* are included several bearded-wheats equally hardy, and requiring as long time to arrive at maturity as our common winter sorts."* Colonel Le Couteur falls into the same error when treating of the classification of wheat, by dividing all wheats into the two distinctions of "beardless or winter-wheats," and "bearded or spring-wheats." †

(2227.) Although the subject is thus rendered by botanists and writers on the cultivated varieties of wheat sufficiently puzzling to the farmer, yet there are a few considerations which may direct you in the choice of your spring-wheat. I may premise that you cannot make a mistake in regard to a winter-wheat; for however early may be the habit of the variety sown, the very circumstance of having sown it in autumn, when there is not sufficient time to mature the plant before winter, will convert it for the time into a winter variety. The wheat plant is a true annual, but when sown late, and the progress of its growth retarded by depression of temperature, it is converted for the time into a biennial. It is therefore highly probable, that, as the nature of all wheats is to

* Lawson's Agriculturist's Manual, p. 1-2.

† Le Couteur on Wheat, p. 78-9.

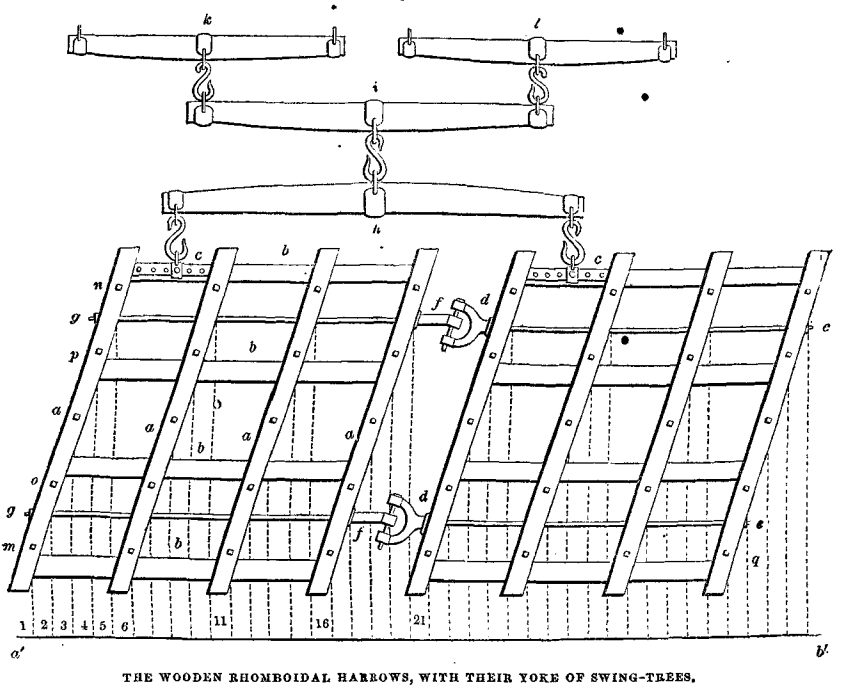
bring their seed to maturity in the course of one season, that any variety sown in spring would mature its seed in the course of the ensuing summer or autumn. I suppose there is no doubt of this being a fact; nevertheless, circumstances concur to render the fact of doubtful application *in this climate.* A variety of wheat, for instance, that has long been cultivated in winter in the same latitude, on being sown in spring will not mature its seed that season in the same latitude, should the temperature fall below its usual average, or should it be cultivated on very inferior soil to what it has been accustomed; so that, in practice, it is not safe, in a precarious climate, to sow *every variety* of wheat in spring. One criterion, however, may safely be applied to any variety of wheat in order to ascertain its character, provided its history is known, which is, that a wheat brought from a warmer to a colder climate, will prove earlier in the latter locality than the native varieties, and, in so far, is better suited for sowing in spring in that latitude than the native varieties, and if you can ascertain, besides, that the same variety is an early one in the warmer latitude—bringing its seed to maturity in a short period, perhaps not exceeding 4 months—then you may safely sow it as a spring-wheat, whether it be a red or white coloured variety.

(2228.) In my own experience of spring-wheat the old Lammas red, and another old variety which I have not heard of for many years, the Cobham red, were at one time considered excellent varieties of spring-wheat. Of the Lammas red, I have seen a field of 35 imperial acres sown on the 8th March, and cut down, an excellent crop, on 26th August. This was, however, in the memorable year for all kinds of good crops, 1815. The variety, I believe, exists to the present day, and is still a favourite with many farmers, and in my opinion deservedly so.

(2229.) [*The Harrow,* considering the operation it has to perform, in covering the seeds that have been cast upon the surface of the soil, is an implement of no small importance; and yet its effects are apparently rude and uncertain, while its construction is of the simplest order. So simple, indeed, is this construction, that at a very remote period it appears to have taken that form which, in so far as the simple principles of its action are concerned, is almost incapable of further improvement. Variations in size, in weight, in materials, and slight changes of form, have from time to time been proposed and effected; but yet no important change has been made in the action of the implement, though amongst these changes a more uniform distribution of its effects over the surface of the soil has been attained. The only important improvement on the harrow of which we have any historical data, was achieved about 50 years ago by, I believe, the late Mr Low, Gordonbank, Berwickshire, father of Professor Low, of the University of Edinburgh; and this improvement lay chiefly in the *form,* but which also afforded a more uniform distribution of effect. Previous to the period just alluded to, the seed-harrow was always constructed in the form of a

rectangular frame of wood, consisting, as it still does, of four longitudinal bars, known, in the language of the agricultural mechanic, by the term *bulls*, which are framed together by mortising, with four lighter transverse bars, or *slots*. The dimensions of the rectangular harrows are, on an average, 3 feet 9 inches in breadth, measuring over the bulls, and 3 feet 10 inches in length over the slots. The bulls are generally about 4 feet 6 inches of extreme length, 3

Fig. 379.



THE WOODEN RHOMBOIDAL HARROWS, WITH THEIR YOKE OF SWING-TREES.

inches in breadth, and 3 to 3½ inches in depth; the slots are 3 inches in breadth, and ⅞ to 1 inch in depth. Each bull is armed with 5 tines or teeth of malleable iron, about 10 inches in length. They are fixed in the bull by being driven into an auger-hole bored through it, and project downward from 6 to 7 inches.

(2230.) The *improved form* given to the harrow, as above alluded to, changes the rectangle into a rhomboid, and this, when duly proportioned, gives to the implement, as has been supposed, as high a degree of perfection, in point of form, as it appears capable of attaining. Fig. 379 represents a pair of the rhomboidal harrows in the working position. The frame of these harrows consists of the same number of parts as the common sort, already alluded to. Four bulls *a a a a*, and four slots *b b b b*, the breadth of the frame over the bulls, at right angles to them, is 3 feet 6 inches; and in the same manner, over the slots the length is the same, but the bulls extend at each end 4 inches beyond the slots, making their entire length, including the obliquity, about 4 feet 6 inches. The dimensions of the parts vary a little, according to the quality of the material employed, from 2½ to 3 inches in breadth by 3 to 3½ inches in depth, for

the bull. The slots are from 2½ to 3 inches in breadth, and from ¾ to 1 inch in depth, the bulls being mortised, and, when the slots have been inserted, are fixed with wooden pegs driven through the bulls. In each harrow an iron bar *c c*, having a number of holes punched in it, is likewise fixed into mortises in the two outer bulls on the left side, for the attachment of the yoke. Each bull is divided into four equal parts, the extreme division being about 1 inch clear of the mortise of the slot, and at each division the bulls are bored with an auger for the reception of the tines, and in thus boring, a slight inclination forward below is given to the tines, though this, it must be admitted, is not of very great importance. The length of the tine is about 10 inches, of which 6 or 7 inches project below the bulls; and it has been recommended that the front row should be 7 inches, the succeeding rows diminishing gradually to 6 inches, to compensate for the effect of draught of the horses tending to elevate the fore-parts of the harrows. This tendency to rise in front is not so great as has been supposed, for the weight of the swing-trees and whole yoke will nearly compensate for the effect of the angle of draught. In all cases of this kind, the yoke, consisting of chains, hooks, and swing-trees, of which the latter, in the harrows-yoke, forms a portion of considerable weight, the system resolves itself into a catenarian curve, more or less perfect, of which the point *c*, where the yoke is attached to the harrow, will approximate to the apex of the curve, and consequently to a horizontal line, thereby neutralizing the tendency to rise in the front of the harrows.

(2231.) There is one point in the improvement of this harrow that appears to me of even more importance than the rhomboidal shape, it is the joints or hinges *d d*. In the one harrow, fig. 379, the tail of the double joints of the hinge is prolonged into a bolt *d e*, *d e*, passing through all the bulls, and secured with screw-nuts at *e e*. The single joints are in like manner prolonged into the bolts *f g*, *f g* thus serving to add greatly to the strength as well as to the efficiency of the harrows. The loose joints *d f*, *d f* have been found to answer their purposes much better than the well-fitted joints originally given to them, by their allowing of a great freedom of action, and the double joints *d d* are therefore now usually made as in the figure, the span of the bow *d* being about 6 inches, with a small eye at each end to fit the joint-bolt. The eye of the single joint *f* is about 1½ or 2 inches diameter, having thus great freedom to play upon the joint-bolt.

(2232.) From the figure of the rhomboidal harrow, when duly constructed, it can only perform its maximum of effect when drawn forward with its slots at right angles to the direction of its motion, and this is effected by the master swing-tree *h*. This tree, for harrows of the dimensions here described, requires to be 4 feet 8 inches in length between the points of attachment, and it is connected to the harrows by means of the S hooks and shackles at *c c*. The balance of draught of the harrows is adjusted by shifting the shackles into the different holes of the bars *c c*, until the harrows are found to lie at right angles to the draught when in motion; and this, be it observed, is not attained by having an equal number of tines on each side of the centre of the swing-tree *h*, for there is found to be a greater resistance to the forward motion of the implement on the left than there is upon the right side, arising, it is supposed, from the tines presenting a broader surface to resistance on that side than on the other. The other parts of the yoke *i*, *k*, *l*, are the common plough swing-trees.

(2233.) The objects to be attained on the construction of the rhomboidal har-

row are chiefly uniformity and equal distribution of effect from the tines, and to cover the greatest breadth of surface, with such effects. In these respects, it has been supposed that the rhomboidal affords advantages over the rectangular form, but such advantages seem to fall only within certain limits; for the rectangular harrow, if due attention is paid to its construction and position of yoking, and if mounted with the hinge-joints, will perform all the functions ascribed to the rhomboidal harrow with equal effect. Though the rectangular form presents no advantage in point of expense, there would be this advantage in construction, that, by keeping simply to one dimension of breadth, no mistake could occur with the maker to mar the attainment of the objects in view; whereas we find rhomboidal harrows made at all angles of obliquity, though the length and breadth may be the same in all; and such being the case, many of them must be defective in some, if not in all the points sought for. To exhibit this more clearly, and to render the basis of construction of this simple implement practically intelligible, let us suppose that a pair of harrows carrying *forty tines* are to be so constructed as to cover 9 feet in breadth, we shall have 39 spaces between the extreme tines, which are to form equal intervals. Draw a base-line a' b', fig. 379, and having set off from a scale, or at full size, a distance a' b' equal to 9 feet, divide this into 39 equal parts, and, from the points of division draw the dotted lines at right angles to a' b', the distance between the divisions will be 2.76 inches, or say $2\frac{3}{4}$ inches, which represents the distance at which the tines will pass through the ground. Having determined, also, the distance between the tines as they stand in the bulls to be $9\frac{1}{2}$ inches: set off, on the first dotted line 1, any distance a' m, which last point m will be the place of the first tine. With a length of 38 inches, or 4 tine spaces as before fixed, set off from the point m a distance m n, cutting the fifth dotted line in n, which last point will be the place of the 5th tine, or the foremost in the first bull. If a line is then drawn through the points m n, it will cut the divisions 2, 3, 4 in the points o a p, indicating the three intermediate tines of the first bull, and the line m n is the true position of the central line of the bull, forming an angle of 73° nearly with the base-line. A line drawn through m to q, and parallel to a' b', will determine the position of the first tine on each succeeding bull, where the line intersects the 6th, 11th, 16th, 21st, &c., of the dotted lines of division, and lines drawn through those last points of intersection parallel to the first line m n, will determine the central line of all the bulls in the pair of harrows. It is then only necessary to extend the length of the bull requisite to contain the mortise for the slot, with a sufficient extent beyond, to prevent the bursting of the wood; this, as already stated, may be about 4 inches, or the bulls will be about $4\frac{1}{2}$ feet in length.

(2234.) Were it desired to have the tines so placed as to follow in the ground at equal distances of $2\frac{1}{2}$ inches instead of $2\frac{3}{4}$ inches, in this case the distance between the extreme tines would be 39 times $2\frac{1}{2}$ inches, or 8 feet $1\frac{1}{2}$ inch. The line a' b', fig. 379, would now be made 8 feet $1\frac{1}{2}$ inch, and being divided into 39 equal parts, and the lines of division drawn as before, a repetition of the process described in (2233.) will give the true form of the rhomb for this particular breadth, and so of any others; and it should be particularly observed, that in any case where the rhomb has been correctly laid down, the harrows should progress with the front row of tines at right angles to the line of direction in which they are drawn forward. Attention to this will insure the best possible

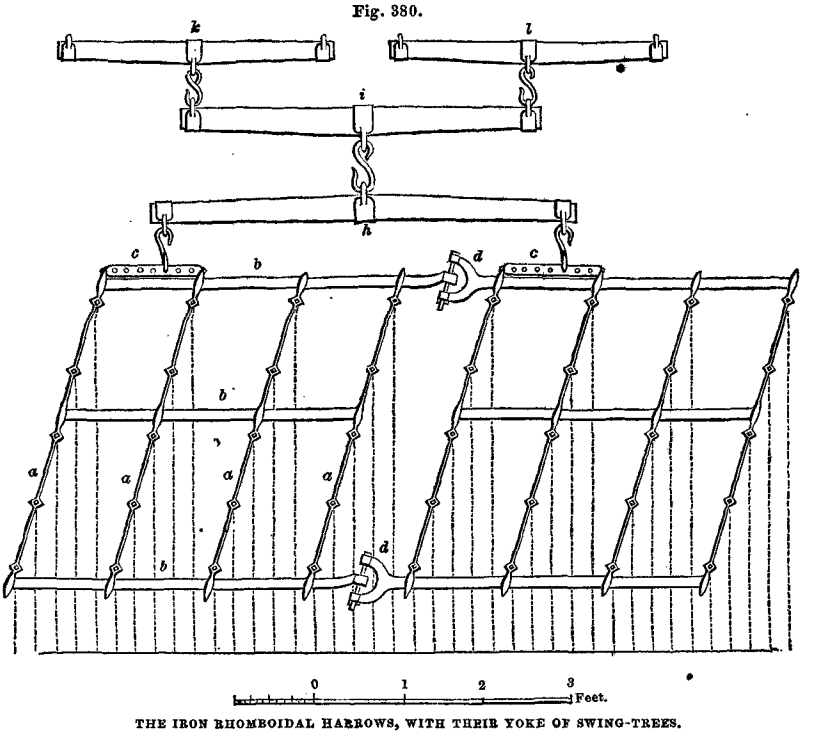
effects from the harrow, and at the same time cover the greatest breadth of surface that it is capable of harrowing, to the best advantage.

(2235.) I have said that the common rectangular harrow is capable of producing equal effects with those of the rhomboidal; and though this cannot be said of all common harrows, the construction of such as will do this is not more difficult, while it is, perhaps, a little less expensive. The chief difference lies in the mode of applying this harrow, for, when duly constructed, it is only necessary, in order to produce equal intervals of the tines, to yoke the harrows in such position as will make the bulls lie upon the ridge with the same degree of obliquity that those of the rhomboidal shape occupy when they are drawn in the position due to the angle of their respective rhomb. It is necessary, however, in order to secure the due performance of the rectangular harrow, to pay attention to its construction as regards the distance between the bulls, and the rule is simply this. Whatever breadth the pair of harrows are intended to cover, divide the whole breadth into a number of divisions, one less than the whole number of *tines* in the pair, and the distance from centre to centre of the bulls must be made equal to as many of these divisions as there are tines in each bull. Thus, taking the first case of the rhomboidal harrow (2233.) we have 5 times $2\frac{3}{4}$ inches nearly, or $13\frac{3}{4}$ inches for the distance between the centres of the bulls, or 3 feet 8 inches in breadth over all. To complete the arrangement, the harrows must be *jointed* as in the rhomboidal form, and mounted with iron draught-bars, as at *c c*, fig. 379, so that the point of draught can be adjusted to bring the harrows to their proper position; and here it may be remarked, that they should never be drawn by the extreme angle; but if not hinge-jointed, the angle with the second bull, and the fore-slot, will be tolerably near to the true point of draught. A common and a very useful practice has long existed, of coupling two harrows together by a bar of wood or iron, called a rider. This bar falls loosely at each end upon a stud projecting upward from the second bull of each harrow, and the bar being adjusted to that length which keeps the two harrows at their proper distance, serves to prevent them from riding over one another, and to make them cover their full extent of surface. The introduction of the rider was an evident approach to the more perfect modern improvement of the hinge-joints.

(2236.) The extensive application of iron has of late years brought the use of that material to the formation of the harrow as well as of the plough, and iron-harrows are now coming very generally into use, both in the rectangular and the rhomboidal form. Fig. 380 represents the malleable-iron rhomboidal harrow, as commonly constructed, and its dimensions are the same as already given for those of wood. The arrangement of the parts are somewhat different, and, from the nature of the materials, the dimensions of the parts differ also more materially. Thus, the bulls *a a a a* are $\frac{1}{2}$ inch in breadth and 1 inch in depth, swelled out where the mortises for the slots are formed, and also for the tines, their ends projecting only 2 inches beyond the slot. The slots *b b b* are 2 inches in breadth, $\frac{3}{8}$ inch in depth, and there being only three of them, the middle one is so placed as to be free of the middle row of tines; while the end slots are elongated towards the meeting sides of the pair, and are there formed into the hinge-joints *d d*, as formerly described for the wooden-harrows. The draught-bars *c c* are inserted in the projecting ends of the first and second bulls, and retained in round pivot holes; the swing-trees *h i k l* are the same as described

for the wooden-harrows. The construction of the iron-harrow is so similar to the others, that it is unnecessary to enter into further details regarding it; but it may be remarked, that, from the almost imperishable nature of the materials, as compared with wood, there seems every reason to expect the iron implement will entirely supersede the wooden; and though the price of the iron-harrows

Fig. 380.



THE IRON RHOMBOIDAL HARROWS, WITH THEIR YOKE OF SWING-TREES.

is considerably above that of wood, the additional first cost is more than repaid by the greater durability of the iron. There is good reason also to believe, that, by a construction more adapted than the present to the nature of the material, the price may yet be considerably reduced.

(2237.) The *form of the tines* of the harrow, as regards their effects in stirring the soil and covering the seed, is deserving of enquiry. In the wooden implement, we are, from the nature of the material, confined to one form of tine; that which has for its horizontal section an oblong square, the tines in these cases being $\frac{7}{8}$ inch broad by $\frac{5}{8}$ inch thick, must, for the safety of the wood, have the greatest dimension lying in the direction of the fibres of the wood. Another and a better form, for the purpose of stirring the soil, is that which has its cross section forming an exact square of $\frac{3}{4}$ inch on each side, and inserted in the bull with its diagonal pointing in the direction of the progressive motion. This form and position of the tine, however well adapted to the soil, cannot, with propriety or safety to the implement, be used in the wooden harrow, from the powerful tendency it has to split the wood. In the iron implement this difficulty does

not exist; and as this form of tine is in every respect best adapted to the intended purpose, it should never be omitted in the iron-harrow. Whatever be the cross section of the tine, in that part which passes through the bull, the projecting part is tapered towards the point, not uniformly but a little barrelled, and terminates in an obtuse point. In all wooden harrows the tines are simply driven firmly into the wood after it has been bored. In most iron-harrows they are fixed in the same manner; but as the tines are sometimes liable to become loose, when simply inserted and driven down by the hammer, they are, when a more perfect construction is followed, fixed by being driven from below, and secured by a screw-nut above.

(2238.) *Grass-seed Harrows*, or those that are employed for giving a light covering to grass-seeds when sown, differ from the common harrow in no respect except in dimensions and weight. They have generally the same number of tines, bulls, and slots. The breadth over all is about 3 feet, or from that down to 33 inches, and the distance between the tines about 7 inches, giving a length of bull $3\frac{1}{2}$ feet, and the tines vary from 5 to 6 inches in length. Harrows of this description are frequently used by English farmers to give the last turn of harrowing-in grain, and a fine finish to the surface. Grass-seed harrows are made of iron as well as of wood, but withal it is not held as an essential implement, the common harrows being more frequently used for the purpose to which the grass-seed harrow is more especially and almost exclusively adapted.

(2239.) Various other forms of harrows are adapted for special purposes, such as the *bush-harrow*, which is a frame of wood interwoven with the smaller branches or croppings of trees, and in this manner employed instead of the grass-seed harrow described above, and it is also employed for harrowing in top-dressing upon grass.

(2240.) The *Iron-web Harrow* is a late invention by the ingenious and indefatigable Mr Smith, late of Deanston, for the same purpose. It is formed of an assemblage of annular discs of cast-iron, of the size and shape of the common playing quoit; and these are interweaved with iron-wire of about $\frac{1}{4}$ inch diameter, in a certain regular form, until the whole forms a flexible web, in which the discs have liberty to play and roll about within small limits. The web may be 2 yards in length by 1 in breadth, and is simply dragged over the ground, when it is said to give the surface a finish superior to any thing hitherto proposed or introduced.

(2241.) *The Brake-harrow* is only an enlargement of the common implement, wherein every part is increased in size and weight for the purpose of breaking down and pulverizing rough and stubborn land. Brakes are made of various forms, such as rectangular, rhomboidal, and triangular; and every form has its advocates, the preference being given frequently to that which accident had thrown in the way of the experimenter; and without taking measures to compare its effects with those of other forms, the implement is marked as the most perfect of its kind. There appears no good reason for concluding that any one of the above forms is better than another, provided proper weight is put in the implement, and the tines of proper length and number, and disposed in a manner that, with a duly applied draught, will make an equal distribution of its pulverizing effects over the surface which it covers. The extended application of draining, and the increasing employment of the grubber, which I shall shortly have to notice, appear in some measure to be superseding the brake-harrow.

(2242.) *The Broad-cast Sowing-machine* has now come into pretty general

use, especially in those districts where the arable system is under the best management, and on large farms is nearly superseding the process of hand-sowing. It not only sows all the white grains, wheat, barley, oats, when sown broad-cast, in a very uniform manner, and with any desired allowance per acre; but it serves in a superior manner for grass-seeds, in point of distribution, and, in the case of windy weather, is greatly superior to hand-sowing. This last advantage arises chiefly from the low position of the discharging orifices, as compared with the height of the *hand* in sowing; but partly also from the more direct discharge of the seed from the machine; its velocity of discharge likewise, and the distance it has to fall, being always uniform. The nice gradation of the discharge is one of its chief qualifications, for it may be adjusted to sow any required quantity per acre, between the lowest and the highest, that may be judged expedient, and in all cases, from the uniformity of the distribution, a considerable saving in seed may be effected.

(2243.) I have on previous occasions had to notice the rather curious facts of the introduction of certain practices from England into the Scottish system of farming. Such practices have remained either stationary in the former country, or have been but partially extended, whereas the practices thus borrowed by the latter have been improved on, and widely extended. The machine now under consideration is another example of this; for though it appears to have been originally brought into Scotland from Yorkshire, I believe, it is even now but sparingly used in England, while here it is in extensive use in the best arable districts, and still rapidly extending. In the course of some inquiries as to the period when this machine was first adopted in Scotland, I have been enabled, through the kindness of Mr Scouler, Haddington, to fix the time of its introduction to the year 1817, and the first machine so made appears to have been by Mr Robert Lowrie, Edington, who makes the following statement:—"The first broad-cast sowing-machine that came into this county (Berwickshire) was ordered by myself from England from Mr Short of Chiverton by Hackhill; it was a smart thing, wheeled by a man, and was about 8 feet long; it is still in the possession of Mr Wilson of Edington Mains. I got that machine in 1816, and in the following year I made one from it for Mr Wright, late tenant in Prenderguest, which was 15 feet long, and was drawn by one horse. So far as I know, this was the first sowing-machine made in Scotland; and after it had sown Mr Wright's crop of that season, I exhibited the machine at the agricultural shows of Coldstream and Kelso, and received premiums for it at both places; this was in 1817; and in the following year I made one of the same dimensions for Mr Wilson's father, the late Mr Abraham Wilson." From Berwickshire the machine made its way immediately into East Lothian, where the manufacture of it was taken up by the late Mr Adam Scouler after the machines of Mr Lowrie above referred to, and has been successfully carried on by his successors, Messrs Scouler and Company of Haddington. The machine here referred to as having been brought from Chiverton, is the same as are yet to be found in the northern and eastern counties, and used chiefly for sowing grass-seeds; its application to the sowing of grain having made little progress, or it may rather be considered as having been superseded by the drill-system of sowing, so much practised in these counties of England.

(2244.) In the early application of the broad-cast machine, it was mounted on two wheels; but a few years' experience pointed out the advantages of a third

wheel, which was applied to it by Messrs Scouler about the year 1830, the third wheel being applied as a swivel or fore-carriage. The carriage is still subject to considerable variety of construction, but these varieties are not of a nature to alter its general character. A carriage of a nearly triangular form is very generally adopted, the apex being in front over the swivel-bar. A rectangular carriage is also very much employed, and this is the most workmanlike construction, though perhaps not the cheapest, but it is withal the most convenient and useful form. As regards the general construction, an important improvement has been introduced within the last six years; this is, the cutting of the seed-chest into sections. The chest is usually made 18 feet long, which being far beyond the width of any field-gate, produced a necessity for changing the position of the chest when passing through a gateway. It was therefore the practice to lift the chest from its working position parallel to the axle of the machine, and deposit it parallel to the horse-shafts until it had passed through the gate. This was clearly both imperfect and inconvenient, and these defects gave rise to the cutting into sections, the middle part being 9 feet, and the extremes each 4½ feet, so that when the latter are folded up, the extreme length of chest is 9 feet.

(2245.) The illustrations of this machine which I have here given in Plate XXVI. are taken from those manufactured by James Slight and Co., Edinburgh, and they exhibit the machine in its most complete state, embracing the chest in sections, with the mode of supporting the same; this last improvement having, it is believed, been first introduced by the above named house. In Plate XXVI., fig. 372, is a view in perspective of the entire machine, as it appears when in work, and fig. 373 a section, on a scale of ½ inch to a foot, taking the chest transversely through its centre, the carriage being cut in the same line, or parallel to the horse-shafts. In these two figures the same letters mark corresponding parts. The carriage is marked *a b a*, fig. 372, and is a frame of hard wood, the bars of which are from 4 to 5 inches in depth, and 2½ inches in thickness; the dimension of the frame being 7 feet in breadth over all, and 4 feet in length over the rails, of which there are three, as seen at *b b*. The hind wheels *c c* are 34 inches in height, generally formed with cast-iron naves, wooden spokes and fellies; or, as in the figure, the fellies are superseded by a simple hoop of malleable iron 2½ inches by ⅝ inches, which, for light carriages of this description that never travel on hard roads, is found sufficiently serviceable. The axle of these wheels is 1¼ inch diameter, seen at *d* in fig. 373, and is in two lengths supported in pillow-blocks bolted to the lower edge of the bars *a a a* of the frame, and meeting in the middle bearing. The nigh-side wheel is fixed dead upon the axle, carrying the axle round with it to give motion to the pitch-chain *d e* of fig. 373, and which is seen also at *a* in fig. 372, where it is seen as entering the chest. The off-side wheel may in this case be also fixed dead upon the other half of the axle, or it may run loose. But the axle may also be made in one piece, the off-side wheel being left loose, which is necessary for the convenience of turning round, this wheel being disengaged from turning with the other. The front wheel *f*, fig. 373, and seen also partially in fig. 372, is 24 inches diameter, usually of cast-iron, and is supported on the cast-iron sheers *g*, which are 4 inches wide between the arms, and terminates upward in the lower half of the swivel-plate *h*, and this again is furnished with a strong pivot, passing upward through the head *i* of the cast-iron fore-beam *i k*. The head of the fore-beam is formed into a swivel-

plate corresponding to that of the sheers *g*, and is bolted to the two foremost bars *b b* of the carriage. Two small pillars *l*, are cast upon projecting ears of the swivel-plate of the sheers *g*, and bolts passing through these pillars and the splinter-bar *m*, bind these parts firmly together, producing an effective swivel carriage. The horse-shafts *n n*, broken off in fig. 373, are attached to the splinter-bar *m* by means of a long draft-bolt passing through the ends of the shafts, and through eyes fixed in the splinter-bar.

(2246.) The seed chest *o o* is 18 feet in length, formed of $\frac{7}{8}$ inch deal. The breadth of the bottom board is $6\frac{1}{2}$ inches, projecting on one side $2\frac{1}{2}$ inches, forming an apron on which the seed falls from the orifices. The sides of the chest are $10\frac{1}{2}$ inches in depth, and the cover 14 inches in breadth, 9 inches of which forms a hinged flap, as seen in the figure. The chest is bound together upon ends and partitions of hardwood $1\frac{1}{4}$ inch thick; when in sections as here described, each section has two such ends, and the middle section has two partitions in the middle, set at $2\frac{1}{2}$ inches apart. When the chest is in one length, two ends and the two middle partitions only, are required. The joints or hinges of the sections are formed of the iron straps *p p*, two of which are securely riveted on each side of the chest, having eyes formed at the apex *q q*, and through these eyes a small bolt *q*, passes from side to side, which completes the hinge; and by withdrawing the bolt the parts of the chest are at once disengaged. For the better connection of the segments, however, when the machine is in action, the contiguous ends are held in contact by a bolt and nut, as seen at *c'* in fig. 374, which, together with fig. 375, are on a scale of 1 inch to a foot. The two extreme segments also are supported by the light tension chain *i'' i' i' i''*, which passes over the two upright iron stanchions *k k'*, the tops of which *i' i'* form the suspending fulcra for the chain, while its extremities are secured at the points *i'' i''* with adjusting nuts.

(2247.) The *sowing-geer* of the machine consists of the following parts:— The main axle of the carriage is mounted with a pitch chain-wheel 4 inches diameter, placed upon the axle close to the middle bar *a* of fig. 372, and seen in full at *d e*, fig. 373; a corresponding wheel *r* is placed upon a short axle within the seed-chest, and between the two middle partitions of the chest. In this way motion is communicated from the carriage wheels *c*, and their axle to the axle of the small wheel *r*, fig. 373. A light shaft, $\frac{1}{2}$ inch square, is coupled to the ends of the axle of the wheel *r*, extending to each end of the chest; when the chest is entire, each of these shafts is also entire; but in the present case each shaft is in two pieces, coupled at the junction of the segments of the chest by means of small clutch couplings attached to the ends of the shaft, and these engage or disengage of themselves when the segments of the chest are let down or folded up. These last mentioned shafts are supported in bearings of hardwood laid in the bottom of the chest, at distances of from 2 to $2\frac{1}{2}$ feet, and the journals, which are $1\frac{1}{2}$ inch long, covered with straps of stout hoop-iron. The shafts are armed with the seed-wheels of the form as shewn at *r* in fig. 374, which are placed upon it at distances of $6\frac{1}{2}$ inches, 32 wheels being required for an 18 feet chest. The seed-wheels have suffered a variety of changes: originally, circular brushes were employed; then came wooden naves, of about 3 inches in length and $2\frac{1}{2}$ inches in diameter; and into these were inserted leaves or teeth of hoop-iron, about 1 inch broad and 1 inch long, and this form of wheel is still much employed. In the progressive stages of the machine, it was furnished with one set of these small shafts carrying brushes, and another set carrying wheels, as above described; the former being then thought necessary for sowing grass-seeds, and

the latter were employed for grains: observation shortly pointed out that the toothed wheels were equally well adapted for either grass-seeds or grain, and he brushes have consequently been laid aside. The wheels represented by *r*, fig. 374, are of cast-iron, of very light fabric; they are ten-toothed, and are 4¼ inches diameter, measuring to the extreme points in the cross section; the points of the teeth are slightly rounded to adapt them to the concave groove or cup that is formed in the back of the chest around each discharging orifice; the wheels are cast with a square eye, and fixed upon the shaft by barbing the angles of the shaft round the eye of the wheel.

(2248.) Corresponding to each seed-wheel, a discharging orifice *s* is formed in the back of the chest; these are ⅞ inch diameter, and their centre is 1½ inches above the apron-board *f w*. On the inside of the back-board, oval excavations are made in the wood around the orifices, leaving the bottom of the cups or edges of the orifice not exceeding $\frac{1}{16}$ inch thick; and in this oval cup the seed-wheel sinks until the point of the teeth are only ⅛ inch clear of the bottom of the cup or the edges of the orifice as seen at *s*. The position of the seed-wheels in relation to the bottom *f u* of the chest, is such as to make the teeth turn at about ¼ inch clear of the bottom. The seed orifices are defended by the iron plates *d'* fig. 375, of a triangular form, the apices *d'* are driven into the apron which secures that point of the plates, and the other two points are fixed by nailing. The fixing of the plates requires some attention, in order that the orifices may exactly coincide with those of the slide *t t*; without perfect coincidence in these two parts the sowing will be unequal.

(2249.) The slide is a bar of hoop-iron 2 inches in breadth, and about $\frac{1}{12}$ inch in thickness; it is perforated at the regular distance by means of a punching instrument, and gauged to determine the precise intervals. In the entire chest, the slide is in two lengths, but in that now described each half is again cut in two at the junction of the sections, and connected by a slip hinge-joint. The slide is held in its place by the small clasps *e' e'*, and a clamp *f* is riveted upon it at any convenient point; the short arm of the lever *w* enters an opening in this clamp, while its fulcrum lies in the plate *b*, which carries a perforated stud, and is fixed on the back of the chest as in fig. 374, forming the fulcrum of the lever, by means of which the slide is moved over the seed-orifices. To effect the precise adjustment of the orifices, the slide is made in two halves, and, at each end of the chest, an adjusting screw *v* acts in a nut attached to the end of the chest, the point of each screw being brought to bear against the end of the slide, which is here thickened to meet the point of the screw. The adjustment will be understood by reference to fig. 375, which represents a portion of the slide of the left hand half of the chest. The slide is here supposed to have been pushed towards the right hand by means of the adjusting screw *v*, fig. 372, till the orifices have been reduced to the desired size, as here shewn in fig. 375 about half shut; in this state the machine is supposed to be fit for sowing, and that it has reached the end of the field, when it becomes necessary to shut while turning; the shutting is effected by moving the slide still further to the right hand, by means of the lever, until the orifices are entirely closed. Both ends of the chest having undergone this operation, which is done in an instant, but in reverse directions, the machine may go to any distance without discharging a grain; but whenever it has been turned into the next ridge, the levers *w* are thrown in the opposite direction, moving the slide towards the adjusting screw *v*, and this being done at both ends, the orifices will have attained precisely the same area as before, and thus the shutting and opening again to the same area; and of course the same discharge is

effected for any number of turns without the smallest variation, so long as the screw *v* remains unaltered.

(2250.) For the purpose of equalizing the distribution of the seed over the surface of the ground after it has left the discharging orifice, the bottom-board *f w* of the seed-chest is made to project beyond the back of the chest about $2\frac{1}{2}$ inches, as at *w*, fig. 374, forming an *apron* on which the seed is first received from the orifice, and being thus checked in its descent, is thereby more uniformly scattered over the surface. Another precaution is taken, the better to secure a uniform discharge, in the case of sowing on ground that has a high inclination. In sowing up hill, in such situations the weight of the seed is thrown more upon that side of the chest from which it is discharged, tending thereby to increase the discharge. On sowing down hill, on the other hand, the effect of pressure is reversed, and the discharge will be less. To obviate these inconveniences, Messrs Scouler, amongst their other improvements in this machine, introduced a tilting motion to the seed-chest in the following manner :—On the two outward bearers *a a* of the carriage-bolsters *y y*, having a semicircular seat of about 8 inches diameter, and corresponding to these, on the bottom of the chest, are formed two circular bearings or journals *y y e* on the bottom of the chest and concentric with the shaft of the seed-wheels *r*, fig. 373 and 374. Upon these journals the chest can be tilted to a certain extent backward or forward, and this is effected by the lever *z*, which may be variously attached to the chest. In the present case it is a fork thrust into two apertures in the chest, forming a lever, whose arm is retained in the sheers of the quadrant *a'*, and by raising or depressing the lever *z*, the chest is tilted backward or forward as the sower sees it necessary; the lever being retained in the required position by a bolt passed through the lever and the then corresponding hole in the quadrant.

(2251.) As the seed-chest is 18 feet in length, and it may sometimes be desirable to reduce its breadth of sowing to 16 or to 15 feet, suiting ridges of these breadths; the reduction is effected by stopping two, three, or more of the seed-orifices at each end. For this purpose, the orifices intended to be stopt are provided with a flat swing clasp, turning upon a pin to which it is riveted, and having a flat tail which is brought over the orifice that is to be stopt. Two of these clasps are seen at each end of fig. 372, under *x*, where they are in the position that leaves the orifice open.

(2252.) The *sowing geer* of this machine has undergone a variety of changes. In the example before us, the pitch-chain is employed to communicate motion from the first mover—the carriage-axle—to the seed-wheels. It has the property of great simplicity, but has been objected to on the score of its keeping the seed-wheels constantly in motion, whether sowing or not, which has been supposed to have a tendency to injure the grain that lies in contact with the wheels. Perhaps there may be grounds for this supposition; but if it do exist, the deterioration must be very trifling. Be these surmises what they may, they have given rise to the means of prevention, by employing a geering that disengages the seed-wheels from the first mover when the machine is being moved, and no discharge of seed required. Fig. 376 represents a very perfect and convenient arrangement of this kind, and which has been very successfully employed; but is a little more expensive than the chain-geering. *a* is the seed-chest, *b b* a part of the carriage, and *o o* the middle and back transverse-bars of the same (corresponding to *b b*, fig. 372). The bar *f e* is one side of a light

cast-iron sheers, which is bolted to the bars *o o* (standing in place of the middle longitudinal bar *a* of fig. 372); and the three equal wheels *c c c* are set in the sheers—the first of the three being upon the carriage-axle, which is in halves as before, and the meeting-ends supported on the sheers *c*. The last of the three wheels takes into the wheel *h*, mounted on the central portion of the seed-wheel shaft, as before described in (2247); and *d* is a fourth wheel, of equal size with *c c*, mounted on the lever *g*, which is forked to receive the wheel *d*, and to embrace the sheers *f e* at *e*, upon which last point the lever turns as a fulcrum. It will be evident, that, by lifting the lever *g*, and throwing it forward upon the seed-chest, the wheel *d* will be ungeered from the first wheel *c*; and though it remains in contact with the middle wheel *c*, no motion will be communicated to the seed-wheels, until the lever is returned to its original position.

(2253.) In using the broad-cast machine, it is frequently drawn by one horse; but it forms a rather heavy draught, and is, therefore, more frequently the work of two horses. The chest is filled from end to end with the seed-corn, and, the horses walking in the furrow, the machine sows the half ridge on either side. When the chest has been filled, and the machine brought to that position which places the horses in the furrow,—the sower having previously determined the degree of opening in the orifices that will deliver the desired quantity per acre, he throws each slide outward against its graduating screw, which will produce the proper opening (2249); and this done, the horses are driven forward. On arriving at the farther end of the ridge, and before entering upon the head-ridge, the slides are withdrawn towards the centre, closing up the vents; the machine is then turned round on the head-ridge, and takes up a position on the next furrow, when the process is repeated, and so on till the field is sown all over, the head-ridges being the last portion of the work; and here the blinding of the extreme orifices come frequently into play, if the head-ridges are of less breadth than those of the field.

(2254.) It has often been suggested that a register screw or index would be a useful appendage to the machine, by which the sower could at once fix upon the extent of opening in the seed-vents. This addition, however well it may appear in theory, appears, in the practical application of the machine, to be of little value; for the eye of an experienced sower will, on passing over a few yards with the machine, by simple ocular inspection, be able to judge of the quantity of seed he is bestowing upon the soil. If experimental accuracy is required, the sower may then put into the chest as much grain as will just cover the seed-wheels, and then *measure* in, one or two bushels, and proceed to sow this until as much remains as will just cover the wheels again, so that the measured quantity is found to have been discharged. By now measuring the number of yards in length that have been sown with two bushels, he will ascertain by calculation the proportional quantity required for an acre. Thus, let the intended quantity to be sown upon an acre be 5 bushels, and that 1 bushel has been sown in the experiment which has covered 140 yards of the 18 feet ridge, or 2 half-ridges equal to 18 feet, or 6 yards. The imperial acre contains 4840 square yards, and this divided by 6, the yards in the breadth of the ridge, we have $806\frac{2}{3}$ as the number of lineal yards in length of an 18 feet ridge to make up an acre; and $\frac{1}{5}$ of this, or 161.2 lineal yards, is the extent that should have been covered by 1 bushel of seed-corn. The machine having, as supposed, covered only 140 yards, it follows that the sowing is about $\frac{1}{8}$ part of the bushel too thick: the graduating screws, therefore, must be turned forward about half a turn,

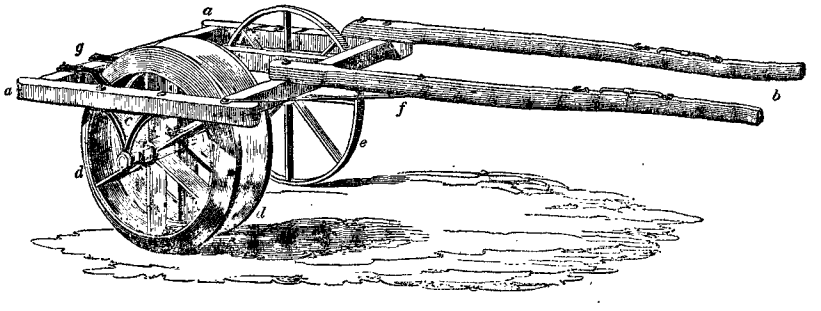
and the experiment repeated if thought necessary. It is seldom, however, that such experiments will be required in the hands of a practical sower.

(2255.) In reference to the inconvenience attending the great length of the seed-chest as taken notice of at (2244), when it is in one length, there remains to be observed, that the method by which it is shifted is this:—in its working state, the chest is kept in its bolsters by means of two quadrants attached to the lower part of the chest, one being on each side of the carriage; these are formed concentric with the curvature of the bolster *y y*, fig. 373, and a bolt, over which the quadrant slides, is screwed into the side of the carriage, and this retains the chest in its place. When it is found necessary to move the chest, the two bolts are unscrewed, which sets the chest at liberty; it is then lifted from its bolsters and laid longitudinally on the carriage. In this operation, however, the pitch-chain, when that medium of power is employed, has to be disengaged by withdrawing a coupling-link from the chain; but when the medium, fig. 376, is employed, there is nothing required but the unscrewing of the quadrant-bolts, to set the chest at liberty. It is then lifted and laid longitudinally on the carriage as before. The price of these machines ranges from L.10 to L.12.

(2256.) *The Presser-Roller* is an implement of very recent introduction to the operations of the farm, and, like many others of the useful class of agricultural machines, its origin is to be traced to England. Although the presser does not take its place in the first rank, yet it possesses qualities whose effects on the soil give it a position by no means low in the scale of usefulness. The chief object of its application is to produce consolidation in the soil over a narrow space, in which space the seeds of plants are to have root; hence its effects are applicable only to the drill system of culture, and that only under particular circumstances, namely, consolidating soils whose texture is too loose and friable for the continued support of wheat plants, and to produce close contact in the furrow-slices of lea when ploughed for a seed-furrow.

(2257.) The *presser-roller* is represented in its most common form by fig. 381, which is a view of the machine in perspective, and is of extremely simple

Fig. 381.

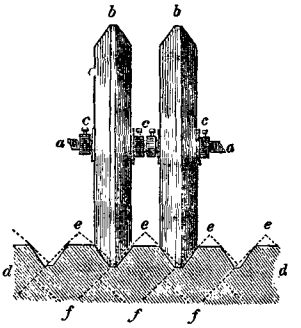


THE PRESSER-ROLLER.

construction. The carriage consists of a rectangular frame *a a*, its length over the front and back bars is 3 feet 8 inches, and its breadth over the sides 4 feet 8 inches; a third longitudinal bar is introduced between those of the back and

front solely to increase the rigidity of the carriage-frame. A pair of horse-shafts *b*, are bolted upon the frame, the nigh-side shaft being laid upon the side-rail, and the other at the usual distance, to afford space for a horse to travel. A cast-iron bracket is appended by bolting to each side-rail: one of these is seen at *c*; its eye or centre descends to a distance of 8 inches below the bottom of the rail; an axle of 2 inches square extends between, and is supported in the eye of the bracket in which it turns upon its journals; this axle carries the two pressing-wheels *d d*, which are fitted to turn with the axle, but are moveable in the transverse direction, and provided with the means of being fixed at any desired distance apart, though 9 to 10 inches is the usual space. The axle carries also the light carriage-wheel *e*, of 2 feet 10 inches diameter, which may be placed either outside or inside of the carriage-frame, and is usually made of cast-iron, turning upon the axle, this being requisite for the more convenient turning round of the machine. The off-side shaft *b*, having but an imperfect connection to the carriage-frame, is supported by the iron stay-rod *f*; and two iron-scrapers *g*, are attached to the hind bar for the purpose of throwing off any soil that may adhere to the wheels. Fig. 382, is an edge-view of the two pressing-wheels detached from the carriage, in which *a a* is the axle broken off, *b b* are the two pressing-wheels as they appear edgeways; they are 2 feet 10 inches of extreme diameter, and their breadth 5½ inches, their weight being about 2 cwt. each; the rim or periphery of the wheel is sloped off on both sides to an angle of about 70°, forming two opposite conical frusta, but a cylindrical band is left in the middle of about 1½ inches in breadth. The pressing-wheels are held at the required distance by the square collars *c c c* fitting round the axle and sliding upon it to the proposed distance apart, where they are fixed by the pinching-screws *c c c*. *d d* represents a transverse section of ground undergoing the pressing process; the shaded part of the section exhibits the state of a soft loose soil when pressed by the roller, and the dotted lines *ef*, *ef*, that of newly ploughed lea undergoing the operation of consolidation.

Fig. 382.



EDGE VIEW OF THE PRESSING-WHEELS.

(2258.) As explained in the text above, and with reference again to fig. 381, the pressing-wheels are to be understood as running always upon the last turned up furrows but one; while the carriage-wheel runs always upon the solid land, where the horse also walks, the shafts being placed at that side. But the presser is now being more advantageously used as to *time*, in the consolidation of soft soils, by being constructed with *four*, *six*, or more pressing-wheels; and in this form the carriage-wheel is not required. In using the presser of this construction, the field must be ploughed for the seed-furrow all over, either entirely or in part, before the pressing is begun; and the field is regularly gone over by the presser, which, from its now increased weight, will require two horses. In this form, with six pressing-wheels, and with the two horses, the machine will press-roll from eight to nine acres in a day. There remains to be observed, in regard to the last form of the machine, that, in order to secure facility of

turning about, the wheels must either be all set upon a round axle, or they must be set upon an axle in two lengths, if it is continued of a square form; and there is consequently required a middle *bearing* for the meeting-ends of the axle. For this purpose, a third bracket is appended to the middle rail of the frame, fig. 381. I have found both of these modes of construction perfectly suitable in practice; and the entire weight of the six-wheel rollers amounts to about 12 or 13 cwt. The price of the two-wheeled presser is L.6, 10s.; and for each additional wheel, with its mounting, L.1, 12s.

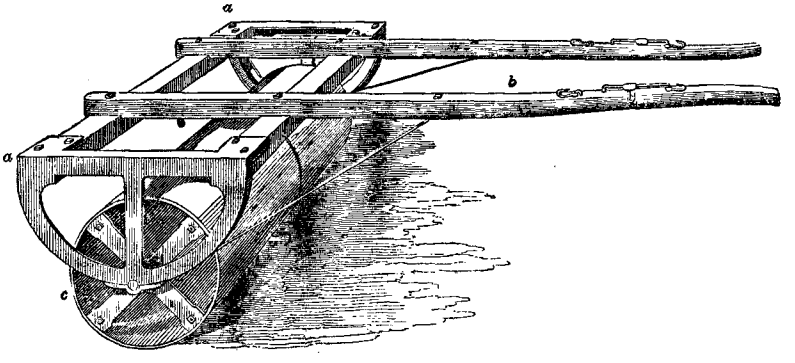
(2259.) The common *Land-Roller* is an implement of great simplicity of construction, the acting part of it being a cylinder of wood, of stone, or of metal, and in many cases its only appendage is a rectangular frame of wood, consisting of two strong end-bars, selected for having a curvature to keep clear of the ground. In these the gudgeons of the roller are borne, and which are connected by two transverse rails, to one of which the horses are yoked. Simple as this implement appears, there is hardly an article of the establishment in which the farmer is more liable to fall into error in his selection. From the nature of its action, and its intended effects on the soil, there are two elements that should be particularly kept in view—*weight* and *diameter* of the cylinder. By the former alone can the desired effects be produced in the highest degree, but these will be always modified by the diameter. Thus, a cylinder of any given weight will produce a greater pulverizing effect if its diameter is one foot, than the same weight would produce if the diameter were two feet; but then the one of lesser diameter will be much worse to draw; hence it becomes necessary to choose a mean of these opposing principles. In doing this, the material of the cylinder comes to be considered. In the first place, wood, which is frequently employed for the formation of land-rollers, may be considered as least adapted of all materials for the purpose; its deficiency of weight and liability to decay renders it the most objectionable of all others. Second, stone, though not deficient in weight, possesses one marked disadvantage, liability to fracture; this of itself is sufficient to place stone rollers in a doubtful position as to fitness. This brings us to cast-iron, which is undoubtedly the most appropriate of all materials for this purpose. It is unnecessary here to enter into the inquiry as to the most advantageous diameter for a land-roller; the subject has already been elaborately discussed:* let it suffice to say, that experience has proved that a diameter of 2 feet is, under any circumstances, the one that will produce the best effects with a minimum of labour from the animals of draught; the weight being of course proportioned to the force usually applied, which is in general two horses. The weight of roller, including frame corresponding to this, is from 12 to 15 cwt.; but it is better that the roller itself be rather under the weight, and that the carriage be fitted up with a box, in which a loading of stones can be stowed, to bring the machine up to any desired weight. In a large and heavy roller, in one entire cylinder, the inconvenience of turning at the headlands is very considerable, and has given rise to the improvement of having the cylinder in two lengths; this, with a properly constructed carriage, produces the land-roller in its most perfect form.

(2260.) Fig. 383 is a perspective of the land-roller constructed on the foregoing principles. *a a* is the carriage-frame, consisting of two semicircular ends of cast-iron, connected by two transverse bars of hard wood, and these last are

* Quarterly Journal of Agriculture, vol. i. p. 700.

crossed by the horse-shafts, *b*. The cylinder *c* is in two lengths of 3 feet to 3 feet 3 inches each, and 2 feet in diameter; the thickness of the metal is from ¾ of an inch to 1 inch, according to the weight required; and each half length of the cylinder has a cross fitted into each end, through the centres of which the axle passes. The axle, in consequence of the cylinder being in two lengths, requires to be of considerable strength, usually 2¼ inches diameter, and of mal-

Fig. 383.



THE LAND-ROLLER.

leable iron; upon this the two sections of the cylinder revolves freely, and the extremities of the axle are supported in bushes formed in the lower part of the semicircular end-frames. Two iron stay-rods pass from the end frames to the shafts as an additional support to the latter. The price of the land-roller, fitted up as here represented and described, is, according to weight, from L.10 to L.14.

---

50. OF SOWING BEANS, PEASE, TARES, LUCERN, SAINTFOIN, FLAX, AND HEMP.

"Go plow in the stubble, for now is the season
For sowing of fetches, of beanes, and of peason."
TUSSER.

(2261.) The next field-labour performed in spring, with the view of reaping a crop in the ensuing harvest, is the preparation of the land for the sowing of *beans;* not that the culture of this crop is general, for beans are not and cannot *profitably* be cultivated on every species of soil; they requiring the heavier and deeper class of soils, usually termed clays and clay-loams. Indeed, their culture was wont to be confined to the heavier sorts of clay; but now the mellower loams are made to bear

that crop, and a still lighter class is sometimes devoted to it, assisted by the aid of manure. Beans may be raised on strong soils without manure, on light they cannot be to any advantage without.

(2262.) The particular culture practised for raising beans is not dependent on the nature of the soil, but is meant to suit the nature of that plant's growth, and the state of the soil in reference to cleanliness. From the structure of the plant, which bears fruit-pods on its stem near the ground as well as at the top, it is obvious that it should have both light and air; and its leaves being situate near the top, and its stem comparatively left bare of them, plenty of room near the ground is afforded to wild plants to grow in company with it. The plant possessing these properties, it is obvious that unless air is admitted to it, and opportunity afforded for removing weeds from it, it will not grow with that luxuriance which its nature would lead us to expect, if placed in favourable circumstances.

(2263.) Now, there is only one way by which both these objects can be secured to the plant, which is, to place it in *rows* or *drills*. The air will then reach both sides of every row; and if the rows are placed so far asunder as to allow weeds to be removed as they grow up, the two objects of constitutional vigour of plant and cleanliness of soil will be attained; and, accordingly, beans are now usually sown in drills.

(2264.) Years ago they were wont to be sown *broad-cast;* but though the plants may have stood in this position as far asunder as to afford to each sufficient air, it would almost be impracticable to destroy the weeds that might grow up amongst them, at least *they* would have as good a chance to grow as the beans themselves. It is true they might be pulled up by hand between the plants of beans, or destroyed by means of some small instrument, such as the hand-hoe, with which you shall become acquainted by-and-by; but such a mode of extirpating weeds several times in a season would not only be tedious but expensive, compared to the labour of the horse, by any instrument suited to his mode of working. There are farmers, however, who still sow beans broad-cast, though the reason for persisting in the practice is not very obvious, even were the land as clean as not to contain a single weed; still the crop, being disposed in rows, would not necessarily encourage weeds to grow, while it would certainly allow more light and air to the plants than the broad-cast method. Be the reasons of the preference for sowing beans broad-cast what they may, the practice is now, compared to the drill-method, very limited.

(2265.) The place which beans occupy in the rotation, or course of crops, is not arbitrary; and no crop can be so treated that is cultivated

in accordance with a predetermined system. They are considered a preparatory crop—though all crops that bear seed to perfection must be exhausters of the soil—because they allow the soil beside them to be worked during a considerable portion of the season; and, in practice, it is found they form an excellent preparation of the soil for wheat.

(2266.) For this reason, beans are raised upon stubble-land that has no grass amongst it, and that stubble may be of wheat or oats. In England, beans are frequently raised on ploughed lea, on which they will grow fully better than on bare stubble-land, because they derive nourishment from the decay of the grass-plants inverted under the soil by the act of ploughing, figs. 105 and 108; but such a course of cropping is objectionable, because it brings two preparatory crops, grass and beans, in succession, whereas a preparatory crop should both follow and precede one that is of an opposite character, such as wheat, barley, or oats. The *reasons* for following particular courses of crops, you shall know after you have been, in the first instance, made acquainted with the *nature* of the crops themselves.

(2267.) With these preliminary observations on the culture of a drilled crop, let us proceed to the practical culture of *beans*. If you look at figs. 140 and 141, in the various modes of ploughing ridges, you will find that the winter-furrows given to land of strong character are cleaving down without and with gore-furrows. The gore-furrows keep the land dry all winter, and it is as good a device for the purpose as is known; and if beans are desired to be raised—for it is not absolutely necessary to raise them in pursuance of any rotation unless you please—the stubble-land which is to be appropriated to their culture would best be ploughed in autumn or winter, as in fig. 141. Suppose, then, you find the land in spring cloven down with gore-furrows, the first operation is to harrow down the furrow-slices *across the ridges*, in doing which, the land being strong, and lying in a rough state, the harrows will take a firm hold of it, and tear it to pieces in a contrary direction from what it had been cut by the plough in winter; and the immediate effect will be, the filling up of the open-furrow *b*, fig. 141, and also of the gore-furrows *a a*; the land, in fact, will be brought down nearly to a flat state. If the land, however, has become very much consolidated in winter, a cross-harrowing will have little effect. It should, in that case, rather be harrowed along the furrows, and even that may prove of little service; seeing which, harrowing may altogether be desisted from. If the land is pretty dry, early as the season yet is, being most likely still in February, it can be harrowed well; but should it not be so dry as to bear the horses without much sinking, it had better be let alone for a few days, or even

a week or two. Dry land and dry weather are both requisite for good harrowing; and in its turn harrowing exposes the land to drought. Every draught of horses should be put to the harrows, to get it done as quickly as possible. Perhaps one double tine will suffice for altogether, at all events, it should suffice for the first time; for, should it require, the next day, a second double turn in an *opposite direction*, the land will be in a much better state for pulverization after a short interval, than if it were harrowed never so often at one time. On the land receiving a thorough harrowing, it is ready for a cross-ploughing, or a ploughing that will at once make it ready for the seed; and this point should be decided according to the circumstance of the case. 1. In the first place, let us take the most favourable state of the case, with plenty of time, with a soil suited to the crop, with the land clean and dry, and with fair weather. With these advantages, the obvious duty of the farmer is to seize the opportunity of working his land in an efficient manner for the benefit of the crop he is about to raise. He will first reduce it to a friable state by cross-ploughing in the manner described from (2154.) to (2161.). He will harrow it again with a double tine *along* the line of the last furrow, and a double tine across it. It will then be ready to receive the seed-furrow, which is of two kinds. *First*, It may be ploughed in single drills in the manner described in (2172.). The bean-barrow, described below, is then wheeled down each drill, depositing the seed at the rate of 5 bushels on fine, and 6 bushels on inferior land, imperial acre. The plough next splits the drills over the sown beans, in the manner described of making double drills, in (2178.), which finishes the operation. *Second*, Instead of being drilled, the land may be ploughed for the seed-furrow in the common way; and the safest form of ploughing it into ridges is to gather it up from the flat, fig. 133; and while this is being done, the bean-barrow is wheeled down the plough-track, and sows the ground in every *third* furrow. As each furrow-slice is about 9 inches in width, the distance between the rows of beans will be 27 inches, the same as the width of drills. The crop will thus grow in rows, as well as when drilled; with this difference, that, in this way, the rows grow on the level ground—in the other, on the tops of drills. When sown on level ground, it should be dry; on wettish land, the drills place the crop in the safest position. 2. Next, let us take the case of a suitable soil, but with little time and the land not in a very clean state. In this case, there will be no time to cross-plough the land; and after the harrowing of the winter furrow, and on the supposition that the land is not in a very clean state, it should be drilled up in the double mode described in (2178.); or should the land be as dry natu-

rally as to admit the rows to be sown on the level ground, the furrow now given should be the opposite of that given before winter. 3. In the case of the land being not altogether suitable to bean-culture, it should be manured; and, indeed, on even the best land for beans, dung should be applied when they follow a crop of wheat that had not been dunged. —The dung can be applied in three ways; *one* upon the stubble before it was ploughed in winter; and, when the land is clean and dry, and there is sufficiency of manure and time at that season, dunging is a good plan for nourishing the soil, and at the same time forwarding the work of spring. *Another* plan of applying the dung is upon the surface in spring before the seed-furrow is ploughed in ridges; and, during which, the seed is sown in every third furrow. In this case, a field-worker should follow every plough, and put the dung in the plough-track with a small dung-graip, fig. 151. And a *third* mode of applying it is in the single drills, along which the beans are sown upon the dung, and the drills afterwards split down with a double-furrow. Of the three modes of dunging, I would prefer that of applying it in drills in spring, provided there be time to do so, and to plough the land well too, and the land can bear cartage; but in case of want of time in spring, and if the land is tolerably clean in autumn, the application of dung then greatly forwards the work in spring, besides possessing the advantage of giving the option of drilling it in spring, or of ridging it with a common furrow. 4. In the case when the land is foul and not very suitable for beans, and the weather unpropitious in spring, it is much better to defer the bean crop altogether, than to render the land by poaching in a worse condition than it was before. When land intended for beans is foul, it should certainly not be dunged in autumn, unless there is time to work and clean it with at least two ploughings and harrowings; and on land not very well suited to beans, if it cannot be dunged either in autumn or spring, that crop should be dispensed with for the season.

(2268.) Cross-ploughing before winter seems to be approved of by some writers for beans, under certain circumstances. Thus the late Mr Brown, Markle, East Lothian, after intimating that the first furrow in early winter for beans should be a deep one, proceeds to say that "the first furrow is *usually* given *across* the field, which is the *best* method when only one spring furrow is intended; but as it is now ascertained that two spring-furrows are highly advantageous, *perhaps the one in winter* ought to be given in length;"* and Professor Low's opinion on this subject bears a similar meaning, when he says, "When the bean is to be

* Brown on Rural Affairs, vol. ii. p. 57.

sown in spring after a corn-crop, the land should receive a deep ploughing before winter, *generally in the direction of the former ridges*, so as to keep the land dry. Sometimes, in case of dry land, the *ploughing may be across the ridges;* and then the plough, passing along the former open furrows, is to form new open furrows in the same place. In either case, care is to be taken to prevent the stagnating of water on any part of the surface."* I would deprecate the permitting of any sort of land to lie in the cross-furrow all winter, and especially land of such consistence as should carry a crop of beans. Having little fear of the consequences, I cross-ploughed a field of 25 acres of hazel loam, resting on a moderately retentive clay subsoil, immediately after harvest, with a view to forward the spring-work for potatoes and turnips, for which crops the soil was well adapted. My object was to ridge up the land before winter; but before this could be set about, the weather threatened a complete change, and instead of being ridged, it was water-furrowed in the open furrow of every ridge, and gaws cut where requisite, in the assurance it would lie in a safe state all winter. In this, however, I was completely mistaken; it worked very unkindly both for potatoes and turnips, and indeed never forgot, during the whole course of the rotation, the souring it received in the cross-furrow; and yet it was of a pleasant light character, upon which I should never have thought of sowing beans.

(2269.) I cannot agree with Mr Brown, when he recommends sowing beans in every third furrow, instead of in drills, when the season is unfavourable, because if land cannot be drilled at all, neither should it be ploughed, nor will it dry so soon after common ploughing as after drilling. Nor do I agree with him that inconveniences must be submitted to in adverse seasons,† because I would change my mode of culture to suit the season. Instead of practising questionable modes of culture, after the land had received a good furrow before winter, I would harrow and immediately drill it in spring with one horse, which would be quite able to make a drill that would cover in beans, while they were being deposited from a barrow in the plough; and both land and seed would remain in this state for some time without harm. This plan possesses the farther advantage of being in time even after the oat-seed is finished; because the land requires no harrowing to lighten the earth above the seed, that being no more than covered when sown, and being in that state it will vegetate 14 days earlier than if it had been ploughed

* Low's Elements of Practical Agriculture, second edition, p. 267.

† Brown on Rural Affairs, vol. ii. p. 58-9.

with the common furrow-slice. When dry weather settles in afterwards, the land can be worked in any manner desired.

(2270.) In consequence of the irregular form of the double-drill causing the germ of the young bean to grow sideways out of the drill, as I explained before (2181.), means should be taken to allow them to grow up straight, and these are harrowing down the tops of the drills, either along or across their direction, in 8 or 10 days after the beans are sown.

(2271.) Of the varieties of the bean, suited to field-culture, I refer to (1944.). I may add, that I have seen the small white Heligoland bean tried in this country in the field, but it did not remunerate the farmer so well as the common kind, besides affording but a scanty crop of straw.

(2272.) *Pease.*—Pease are sown to much less extent than they were some years ago, the change being effected partly from pea-meal having become less an article of food amongst the labouring population, and partly from a nicer sense of cleanly culture entertained by our farmers. It has always been a subject of remark, that annual weeds are much encouraged in growth amongst pease; and besides the pea being a precarious crop, yielding a small return of grain, except in fine growing warm seasons, the mere circumstance of a good crop of straw is insufficient to afford remuneration for a scanty crop of grain, accompanied with a foul state of land. Hence turnips, which comes in the same part of the rotation, have been almost generally substituted for the pea.

(2273.) The pea, for a long period, was sown broadcast; but seeing their tendency to render the land foul, and observing that drill-culture preserved the land clean, it was imagined that pease sown in drills would also admit of the land being cleaned in the intervals. In practice, however, it was discovered that the straw by its rapid growth soon crept along the ground, and prevented the use of the weeding instruments. When sown by themselves, pease are sown thick, not less than 4 or even 4½ bushels per imperial acre; and they may be sown over a considerable space of season, the late varieties as early as February, and the early as late as May.

(2274.) But the more common practice now is to sow pease and beans together, the stems of the latter forming stakes to support the tendrils of the former. The proportion the pea bears to the bean when thus mixed, is as 1 to 3, or sometimes only as many pease are sown as their straw shall serve to bind the sheaves of the beans in harvest.

(2275.) It is somehow considered of little moment how the land shall be ploughed when the pea is to be sown by itself. Sometimes only one furrow after the stubble is given; and when the land is tender, and pretty

clean, a sufficient tilth may be raised in this manner to cover the seed, which requires neither a deep soil for its roots, which are fibrous and spreading near the surface, nor a deep covering of earth above them, 2 inches sufficing for the purpose. But the single furrow does not do justice to the land, however it may suffice for the crop. The land should certainly receive one furrow at least in spring, after the winter furrow; and that furrow may either be a double drilling or an ordinary furrow, according to the mode of culture adopted.

(2276.) Pease may be sown by hand or with a drill. When sown with beans, they are of course always deposited by a drill; when sown on drilled land by hand, the seed falls to the bottom of the drills, and are covered by the harrows being made to pass across the drills. When sown in every third furrow, or in every furrow, which is more commonly the case, the drill of course is used.

(2277.) Like beans, pease are sown on ploughed lea in some parts of England. In Scotland, the farmers know their interest better than to bestow good grass land, that will yield a luxuriant crop of oats, on so generally thriftless a crop as the field-pea. Besides being sown broadcast and by drill, the pea is dibbled in on the face of a flat lea furrow-slice, the holes being placed about 9 inches asunder. When varieties of the white pea are cultivated in the field, as in the southern counties of England, these various modes of sowing them by themselves may deserve attention; and also in the neighbourhood of large towns, where the garden pea may be cultivated in the field, in a green state, for the vegetable market; but in other respects they are inferior to raising them in company with the bean. A mixture of beans and pease are separated by riddling with the corn riddles, from figs. 309 to 314.

(2278.) Since the pea can be cultivated along with the bean, it can grow on strong soils, and it also thrives on very light soils. In the former position, it produces generally a large bulk of straw, and its crop of grain depends on the season being dry and warm; but as these are not the usual characteristics of our clime, the probability agrees with the fact that the pea yields but an indifferent crop. On light soils, its straw being scanty, though the yield of grain may be larger in proportion to the straw on strong soils, it is, on the whole, not usually prolific. Dung is never given to the pea when sown by itself.

(2279.) Of the true field-pea I have already enumerated the varieties in culture in (1950.). Of the garden-pea, suited to field culture, there are several varieties, some of which are extensively cultivated in a few of the counties near London, especially Middlesex, Kent, and Suffolk. The early Charlton has long been in cultivation, and is prolific. The

pearl and blue and white Prussian pease are very prolific. The Carolina, blue scimitar, and blue and green tall and dwarf imperial are also good. The striking distinction between field and garden pease is, that the former has *coloured flowers*, with grey, speckled, and dun seeds; and the latter *white flowers*, with bluish and white seeds.* It is a pity that the Danzig pea yields so poorly in this country, for a more beautifully round, small, bright yellow coloured, transparent pea, cannot be imagined. It is imported, however, for splitting and boiling whole.

(2280.) *Tares.*—The seed of the tare not being an article of food in this country, the plant, *Vicia sativa*, is cultivated for a very different purpose than the bean and pea. Its stem and leaves are found to make an excellent succulent green-food for horses, cattle, and sheep, from spring to winter. The English farmer, however, derives more benefit from this plant than the Scottish, he being able to obtain it from spring to winter, whereas in Scotland the plant only becomes available for use in the later autumnal months. The tare sown in autumn stands the winter of England, but cannot in Scotland, and is there fit for cutting by the end of spring; and if a succession of sowings be made in spring and summer, this valuable forage may be obtained until the very approach of winter.

(2281.) If intended to be sown in autumn, to stand the winter, care should be had to obtain the proper seed; there being two sorts of tares in the market, one called the *winter tare*, which should only be sown in autumn, and the other the *spring tare*, which would be destroyed in winter were it sown in autumn. There being no botanical distinction between the plants to constitute distinct species, the winter tare can only be known by being of smaller growth, and the seed-pods more smooth and cylindrical. There is little difference in the seeds, the winter variety being of more uniform size and small, the spring more varied in size, which characteristic of the latter variety has obtained for the larger-sized the appellation of *vetches*, and for the smaller that of *tares*. The difference of habit in the plant has arisen entirely from difference of circumstances, in being continued to be sown in winter and spring.

(2282.) The usual cultivation given to winter tares is one furrow on the stubble; but if there is time between harvest and winter, and the weather at all favourable to field-work, the land should receive more labour than a single furrow, in justice to itself and the crop. The stubble should at once be cross-ploughed, then harrowed, and then ridged up

* Lawson's Agriculturist's Manual, p. 72–5.

before the seed is sown on it. The winter tare is usually sown without dung, and on rich kindly clays the crop will be good without its assistance; but land in poor condition, and naturally light soils, should be manured. When there is time to give only one furrow in autumn, the dung should be applied on the stubble; but with two furrows, it should be applied in the second ploughing, when the land is ridged up. The reason for preferring the second ploughing in manuring the land is sufficiently obvious, because the second ploughing in ridging up would bring up the unrotted dung ploughed down in the first ploughing.

(2283.) Where the tare stands the winter well, it may be sown alone, with from 2 to 2½ bushels of seed to the imperial acre, according to the condition of the soil; but a little rye amongst it not only protects it from frost, but serves to augment the forage crop in spring. For this purpose 1½ bushel of rye will serve. You may err in sowing tares too thick, which they are when the stems grow small, and the roots are crowded on the ground, when the plant is apt to rot off in damp weather, especially on naturally, or artificially made, rich soils. If the weather and land are sufficiently dry in early spring to allow a light roller to pass over the young tares and rye, the ground will be much improved for the cutting of the crop by the scythe; but if this is considered inexpedient, the crop will have to be cut in spring by hand with the sickle; as it would be improper to roll the ground immediately before winter. Should the tares be got into the ground early in autumn, the ground may then be rolled after being sown.

(2284.) The spring culture of tares is very similar to that of pease when they are to be sown broadcast (2273.), the land being worked as much as the circumstances of the case will permit. Where manure is required, and on all light soils it is desirable for tares, it should, if possible, be applied to the land in autumn; but if not then convenient, it should be put on in a short or well-rotted state before the seed-furrow. From 1½ to 2 bushels of spring tares, and 1 bushel of oats, potato or Hopetoun, not any of the common kinds, which are not strong enough in the stem to support the tares, will suffice on the imperial acre, when the soil is in good heart; if otherwise, and on light soil, the tare-seed should be increased from 2 to 2½ bushels per acre. I have seen a large proportion of a crop of tares destroyed by rotting when sown too thick, and the season of cutting happened to be moist. A close heavy rolling, to finish the culture, serves to consolidate the ground in spring, and to afford a smooth surface for the action of the scythe. The purpose of the oat-stems being not only to augment the cutting of forage, but to assist in supporting the tares, the latter purpose is much better effected

by oats than barley. Wheat would do for a support, but animals are not so fond of it in a green state as of the other two kinds of grain, or of rye.

(2285.) To maintain a succession of cuttings, tares should be sown at intervals from February to the end of May. In doing this, it should be borne in mind, that the periods of cutting will approach nearer each other, from sowings made towards the approach of summer; so that the farther on the season of sowing is advanced, the greater intervals of time should elapse between the sowings, and the larger the space of ground sown at each time.

(2286.) Tares are cultivated for *seed* as well as forage, and the culture, as far as the soil is concerned, is quite the same. The crop, however, is sown in the season intended to raise the sort of seed required. Winter tares should be sown and raised in winter, and the summer tares in spring and summer. It is recommended to sow beans amongst tares intended for seed, to afford them support in climbing; and the proportion the beans should bear to the tares is as 1 is to 4 in measure, but not in number of seeds. Or tares may be cultivated along with beans, sowing them in the proportion of 1 to 4 in measure, that is, 2 bushels of tares to 4 of beans. Beans and tares are easily separated by riddling. Tares intended for seed should be sown as *early* in spring as the state of the land will permit the work to proceed.

(2287.) *Lucern.*—This kind of forage plant has never been successfully cultivated in Scotland, nor has it taken much hold of England. It appears, therefore, unnecessary to occupy much of your attention with a plant which will probably be never serviceable to you as a farmer. Nevertheless, I shall give you an account of its culture, kindly furnished to me by Mr William Pepper, of Falcon Lodge, near Sutton Coldfield, in Warwickshire, who has raised a crop of it for several years. He says that "a light dry soil should be chosen in the neighbourhood of the farmstead, and the deeper it is the better, as lucern has a deep root, which I have known strike as deep as 6 feet. The ground should be quite freed of weeds, and well covered with good foldyard manure, which should either be dug down 18 inches deep with a double spit of the spade, or ploughed down with a double furrow by one plough following another. The best time for sowing the seed is about the middle of March, when it should be sown *broadcast* at the rate of 20 lb. per imperial acre, at a cost of 1s. 8d. per lb. It may be harrowed in with barley, upon land that has carried turnips, as being then in the cleanest state; but it may be sown after grass or stubble, provided the land has been properly laboured and cleaned."

(2288.) I may relate its entire culture at this time. "Towards the latter end of October or beginning of November," continues Mr Pepper, "the lucern should be covered with light stable manure, to preserve it from the frosts during the winter; and towards the beginning of March; in the ensuing season, it should be harrowed with light grass-seed harrows, to remove the few remaining weeds, and rolled. After it has been mown in May for the first time, it would be advisable to scatter over it again a light dressing of manure, in order to encourage the growth of the second crop. When the ground is cleared in the end of the season, it will be necessary to apply harrows upon it of a heavier description than those employed in the season before, as early in the season as the crop will admit; and continue to harrow till the ground is free of all weeds, and almost like a fallow, as the lucern-roots will now have got so deep as not to be injured by harrowing, and when immediately covered with manure, it will be found free of weeds in spring.

(2289.) "This mode of cultivating this useful plant will produce 8 tons of forage per acre; but it should be borne in mind that, when so much is taken from the ground, much manure will require to be given in return. The broadcast plan is very much preferable to drilling. I have known many sow it in drills, and, after a few years, gave it up, in consequence of the great trouble and expense incurred in hoeing and cleaning; but the broadcast system saves all that trouble.

(2290.) "I sowed my lucern in 1830, and have continued mowing and manuring it every year since; and in some seasons I have got as much as 12 tons per acre. It is a hardy plant, and will endure cold if cultivated in dry soil; but it flourishes best in a hot summer, when I have seen it run to the height of 5 feet 5 inches, though its usual stature is about 4 feet; and when all the other grasses were burnt up, it has remained green and succulent It is particularly calculated for horses, though pigs will greedily consume the refuse that comes from the stable, and thrive well upon it; but it is too strong in the stalk for cows, and by no means so good for them as tares. If cultivated upon proper soil, an acre will keep 3 strong cart-horses for 6 months, from 1st May to October; and after the first year may be mowed twice or thrice according to the seasons."

(2291.) *Saintfoin.*—This plant is nearly allied to lucern, and, being a native of Britain, may be cultivated here with greater certainty; but it affects only a particular class of soils, namely, the chalky and gravelly, on both which it will continue to grow with vigour for 8 or 10 years, preferring, however, the former, and not growing kindly on the stronger

soils. It may be cultivated in precisely the same manner as that described by Mr Pepper for lucern. It comes to full maturity of growth in 3 years; and though it will not bear to be cut so many times in the year as lucern, it makes an excellent easily made hay, yielding from 1 to 2 tons per imperial acre, and a pleasant aftermath for stock. It is possible to cultivate both lucern and saintfoin as a one or more years' crop of grass in rotation with corn crops instead of red clover, but in that case they would be better to be accompanied with white clover and rye-grass; and, being a perennial, it would have the advantage of red clover of remaining more than one year in the ground, should it be desired to retain the grass longer upon the ground.

(2292.) There is a remark made by Professor Low, on the expediency of cultivating such plants as lucern and saintfoin in a permanent form by themselves, which is perfectly just. "If ground is to be mown for successive years for forage in such soils as are suited to it, scarce a better crop can be cultivated than saintfoin, which is easily grown, hardy, and productive. But, with regard to this particular mode of cultivation, it cannot be at all recommended. It is not the most beneficial mode of raising crops for forage; for, independently of the smaller produce, the keeping of land under any one kind of crop, and manuring it upon the surface, is to deprive the cultivated land of manure for an object which may be better attained by other means." *

(2293.) *Flax.*—This plant was at one time pretty generally cultivated in this country, and the time is not far gone by when a given space of ground, of ¼ of an acre, was allowed each hind to sow flax upon for his own linen, as a part of his wages. Finding this plant, as usually cultivated, in being permitted to ripen its seed, a severe one for the ground, and more probably because of foreign competition rendering its culture unprofitable, its cultivation here has almost fallen into desuetude. Of late the revival of its culture is spoken of.

(2294.) Flax requires a deep mellow soil, abounding in vegetable matter, removed both from strong clay and gravel; on the former of which the plant would be coarse, and on the latter the crop scanty.

(2295.) Flax is cultivated after grass as well as after corn. In either case, the lands hould be early ploughed in autumn to afford time to receive the melioration of frost in winter. In spring the land cannot be worked too much by ploughing, harrowing, and rolling, to render it as fine as garden-mould. The land should be finely harrowed before the

* Low's Elements of Practical Agriculture, second edition, p. 416.

seed is sown, which should be deposited at a very shallow depth in the soil, say ½ an inch; and to improve the state of the soil still more, it should be rolled heavily and closely before being sown.

(2296.) The seed may be sown any time from the middle of March to the first week of May. Being slippery, it is very difficult to sow by hand, and, consequently, it is very apt to be *laddered.* The seed should be firmly seized by only two fingers and thumb, and sown in short quick casts, and, being dark coloured, it may be observed to fall upon the rolled ground. The quantity of seed required for an imperial acre is from 2 to 2½ bushels when a crop of fibre is desired; for a crop of linseed, less may be sown. The seed is covered in by the grass-seed (2238.) or bush-harrow (2239.).

(2297.) The flax crop cannot bear dung to be immediately applied to the land before it is sown, in case of its becoming too rank and coarse in the fibre; but a sprinkling of 10 or 12 bushels of bone-dust to the imperial acre in autumn or early spring, is said to be of service to the crop, in rendering its fibre finer upon land after a white crop.*

(2298.) Linseed is usually sown broadcast, but it may be sown in rows by ribbing the land lightly with the small-plough, fig. 370, to facilitate the summer weeding. To save weeding, on the other hand, it has been recommended to sow grass-seeds amongst flax; and on the latter crop being pulled, to roll the grass in order to consolidate the land again. These should be taken as experimental hints merely.

(2299.) *Hemp.*—This plant is still less cultivated in this country than the flax. The only instance I ever saw it in cultivation in Scotland, was on the farm of Kinnear, in Fife, when it was possessed by the late Mr Meldrum.

(2300.) Hemp requires a deep, rich, mellow, alluvial, moist soil; and it should, moreover, be heavily manured on the stubble, with not less than 20 tons of dung per imperial acre. The working of the land is in every respect similar to that for flax.

(2301.) Being a tender plant, very susceptible of frost, it should not be sown before the end of April. The quantity of seed sown is the same as for flax, namely, from 2 to 2½ bushels per imperial acre.

(2302.) The bean, pea, tare, lucern, saintfoin, and clover, are plants which all belong to that extensive and most interesting natural family called *Leguminosæ,* so named because the plants composing it bear legumens or pods like the pea. This vast and very natural order is supposed by Humboldt to contain $\frac{1}{12}$th of all the phenogamous plants known, and it is widely diffused over the globe. "It is remarkable that the botanical characters of *Leguminosæ,*" says the late and lamented De Candolle, "should so strictly agree with the pro-

* Warnes' Suggestions for Fattening Cattle on Native Produce, p. 8.

portion of their seeds; the latter may be divided into two sections, namely, the first *Sarcolobæ*, or those of which the cotyledons are thick, and filled with fecula, and destitute of cortical pores, and which, moreover, in germination do not undergo any change, but nourish the young plant by means of that supply of food which they already contain; second, the *Phyllolobæ*, or those of which the cotyledons are thin, with a very little fecula, and furnished with cortical pores, and which change at once into leaves at the time of germination, for the purpose of elaborating food for the young plant. All the seeds of the *sarcolobæ* are used as food in different countries, and none of those of *phyllolobæ* are ever so employed." The papilionaceous or butterfly flowers characterise the greater number of this beautiful family. These plants stand in the order *Diadelphia decandria* of Linnæus's system.

(2303.) *Vicia*, Tare or Vetch.—*Vicia sativa*, or cultivated vetch, is the species whose culture in spring I have described. It is a native of Europe, in corn or cultivated fields; plentiful in Britain; also of North America, about Fort Vancouver. Flower purple. This is a very variable plant in the form of its leaflets, in the size of the stems, and in the colour and size of the seeds. The *Vicia Narbonensis*, Narbonne vetch, and the *Vicia serratifolia*, serrate-leafleted vetch, are cultivated on the continent, and Dr Anderson has recommended the culture of the *Vicia sepium*, hedge-vetch; and a writer in the Bath Papers advocates that of the *Vicia cracca*, tufted-vetch. There are 108 described species of *Vicia*, a name said to be derived from *vincio*, to bind together, because the species have tendrils by which they bind other plants. *Faba*, Bean. *Faba vulgaris*, common bean, is the species cultivated in fields. Name derived from the Greek *phago*, to eat. *Pisum*, Pea: *pis*, in Celtic, means a pea, hence *pisum* in Latin. *Medicago*, Lucern. *Medicago sativa*, cultivated lucern, is the plant whose culture is described above by Mr Pepper. It is a native of Spain, but is now cultivated through Europe in fields. In Britain is hardly a native. Flowers large, violet. The name is derived from *medike*, a name given by Dioscorides to a Median grass. *Medicago lupulina* is the hop-clover, or black nonsuch, which is always sown by some farmers amongst their grass. It grows best in light soils, and is best suited to sheep. *Medicago falcata*, falcate-podded lucern, the flowers of which are usually pale yellow, but occasionally violet and green; and it is said to be the kind of lucern cultivated in Switzerland. There are 81 species of lucern described by botanists. *Onobrychis*, Saintfoin. *Onobrychis sativa*, cultivated saintfoin, is the species cultivated in this country. It is a native of Europe, on all dry calcareous hills. In Britain, on all chalky districts. Flowers variegated, crimson. Name is derived from *oxos* an ass, and *brycho* to gnaw, the plants being grateful to the ass. There are 28 species described by botanists.—*Trifolium*, Clover. This genus includes the most valuable herbage plants adopted in European agriculture, the white, red, and yellow *clover*. Notwithstanding all that has been said of the superiority of *lucern* to *clover*, and of the excellence of *saintfoin* and various other leguminous plants, yet the red *clover* for mowing, and the white species for pasturage, are, and probably ever will be, found to excel all plants in these respects. The yellow clover, and the cow or meadow clover, are also in cultivation, but are inferior to the white and red clover. *Trifolium pratense*, field trefoil or red clover, is the species generally cultivated under that name. Its leaflets are dark green, usually with a white subsagittate mark in the centre. Flowers purple, rarely white. The *soil* best adapted for this clover is deep sandy loam, which is favourable to its long tap-roots; but it will grow

in any soil provided it be dry. Marl, lime, or chalk is very congenial to clover. The *climate* most congenial to it is one neither very hot, nor very dry and cold. Clover will be found to produce most seed in a dry soil and warm temperature; but as the production of seed is only in some situations an object of the farmer's attention, a season rather moist, provided it be warm, is always attended by the most bulky crop of *clover* herbage. Red clover-seed is imported into Britain from France and Holland, where it is raised as an article of commerce. What has been obtained from those countries has been found to die out in the season it has been cut or pastured, while the English seed produces plants which stand over the second and many of them the third year; thus remaining, in the latter case, 4 years in the ground from the time of sowing.* Some prepare clover-seed for sowing by steeping it in water or in oil, as in Switzerland, and then mixing it with powdered gypsum, as a preventive to the attacks of insects. *Trifolium repens*, creeping trefoil, Dutch, white, or sheep's clover, is the white clover cultivated in this country. It is a native of Europe, is plentiful in Britain, and is now cultivated in Jamaica. Mr Curtis affirms that a single seedling covered more than a yard square of ground in one summer. White trefoil is generally called Shamrock, but *Oxalis acetosella* is supposed to be the true Irish shamrock. *Trifolium hybridum*, hybrid trefoil, Alsike clover, is a species possessing the properties of both the red and white clovers, referred to above, and on that account was considered by Linnæus a hybrid between them. It is a native of the south of Europe; but has been introduced into the agriculture of Germany and of Sweden, where, in the latter country, it is cultivated to considerable extent in the district of Alsike. The late Mr George Stephens, after seeing the success of Mr Lawson in raising this species of clover in 1834 and 1835,† selected a quantity of it in Sweden the year following, consisting of about 2 bushels, which was somehow lost on the voyage; so farther experiments were checked in Scotland with this promising-looking clover, for a clover that would prove to possess the strength of the red with the permanency of the white clover, could not fail to be a valuable acquisition to the agriculture of this country. *Trifolium medium*, meadow trefoil, or cow-clover. I suspect that the true cow-clover, indicated by this name, has been confounded with the perennial variety of red clover, *Trifolium pratense perenne*, otherwise so worthless a weed would never have been recommended as a valuable constituent for our permanent pastures on light soils, where it never fails, by its obtrusive character, to destroy the more valuable pasture plants around it. Indeed, Mr Sinclair owns, that "the *Trifolium medium* is inadmissible in alternate husbandry, on account of its creeping roots, constituting what, in arable land, is termed *twitch*;" and the twitch is most abundant, and therefore most troublesome, in light soils, not only in arable fields, as just expressed, but in pasture, where it usurps the place of better plants; and yet Mr Sinclair says, that "for soils of drier nature and lighter texture, the *Trifolium medium* offers great advantages."‡ *Trifolium incarnatum*, flesh-coloured-flowered trefoil, being a native of the south of Europe, does not seem to be yet naturalized to our climate. It may make good food for cattle, as Mr Miller thinks, but, being an annual plant, it will not suit with the common practice of farmers. *Trifolium ochroleucum*, cream-coloured-flowered trefoil. Mr Curtis

* Sinclair's General Report of the Agriculture of Scotland, vol. i. p. 537.

† Lawson's Agriculturist's Manual, p. 153.

‡ Sinclair's Hortus Gramineus Woburnensis, p. 222, edition of 1824.

recommends this species of clover to the notice of the experimental agriculturist, and even thinks it may be a good substitute for red or white clover, in certain soils and situations, but I think with Mr Don, that it is in no respects worthy of attention as an object of culture. *Trifolium Alexandrinum*, Alexandrian trefoil. Flowers pale yellow. Forksall says that this trefoil is universally cultivated in Egypt, being the best and indeed the principal fodder for cattle in that country. It is sown only in the recess of the Nile, and, where the fields are too high to be inundated by that river, they are watered by means of hydraulic engines, the seeds being committed to the earth while it is wet. The produce is 3 separate crops, the plants growing each time about ½ an ell in height. After the last crop the plant dies. When this trefoil is wanted for seed, it is sown along with the wheat. Both are gathered at once by the hand, not reaped or mown, and are thrashed out together, the tre-foilseed being afterwards separated by a sieve. This species of clover being so important in its own country, might be worth the notice of British agriculturists. *Trifolium procumbens*, procumbent trefoil, yellow clover, or hop trefoil. This species of clover seems to be confounded with the procumbent lucern, *Medicago lupulina*. Its flowers are yellow. Its name of *hop*-trefoil is bestowed on it with much propriety, the heads being larger and more resembling the hop than any of the rest of the species. It is common on the borders of fields in dry gravelly soils. In some meadows it forms a considerable part of the crop, and makes excellent fodder; and it is now very generally used for pasture, with or without white clover. These are all the species of clover that seem to deserve special notice, out of 166 described by botanists. The name trefoil is derived from *tres*, three, and *folium*, a leaf; all the species of the genus having trifoliate leaves, or each leaf is composed of 3 leaflets.*

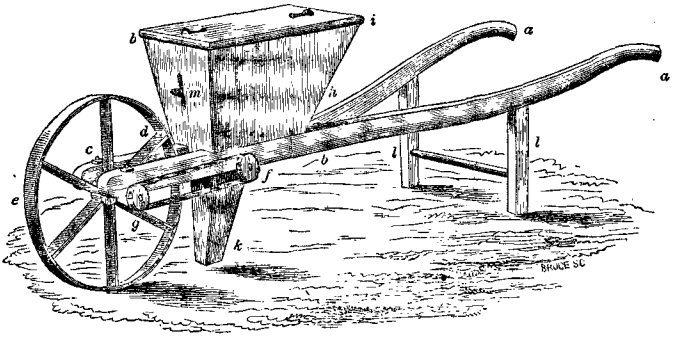
(2304.) "Some years ago," says Mr Babbage, "a mode of preparing old clover and trefoil seeds, by a process called '*doctoring*,' became so prevalent as to excite the attention of the House of Commons. It appeared in evidence before a committee, that the old seed of the white clover was *doctored* by first wetting it slightly, and then drying it in the fumes of burning sulphur; and that the red clover-seed had its colour improved by shaking it in a sack with a small quantity of indigo; but this being detected after a time, the *doctors* then used a preparation of logwood, fixed by a little copperas, and sometimes of verdigris; thus at once improving the appearance of the old seed, and diminishing, if not destroying, its vegetative power, already enfeebled by age. Supposing no injury had resulted to good seed so prepared, it was proved, from the improved appearance, its market-price would be enhanced by this process from 5s. to 25s. per cwt. But the greatest evil arose from the circumstance of these processes rendering old and worthless seed in appearance equal to the best. One witness tried some *doctored* seed, and found that not above 1 in 100 grains grew, and that those which did vegetate died away afterwards; whilst about 80 or 90 per cent. of good seed usually grows. The seed so treated was sold to retail dealers in the country, who, of course, endeavoured to purchase at the cheapest rate, and from them it got into the hands of the farmers; neither of these classes being at all capable of distinguishing the fraudulent from the genuine seed. Many cultivators, in consequence, diminished their consumption of the article; and others were

* Don's General System of Gardening and Botany, vol. ii. Natural order, *Leguminosæ*, from which valuable work most of the preceding information is derived.

obliged to pay a higher price to those who had skill to distinguish the mixed seed, and who had integrity and character to prevent them from dealing in it."*

(2305.) [The *Bean-drill* or *Bean-barrow* is one of the simplest in its construction of that class of machines which I shall now have occasion to notice, and which are employed for depositing the various kinds of seeds in the soil in the drill system. The bean-drill is made in a form resembling a wheelbarrow, and

Fig. 384.



THE BEAN-DRILL.

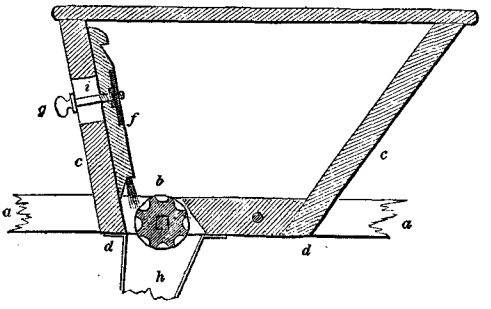
hence its name. Fig. 384 is a view in perspective of the machine in its most common form; *a a b c* are a pair of stiles worked to a particular curve, that, when joined to form the bed-frame of the barrow, has the portion from *b* to *c* parallel, and about 6 inches wide over all; while the parts from *b* to *a* spread out to a width of 2 feet, forming the handles of the barrow. The body parts *b c* are $2\frac{1}{2}$ inches in depth and $1\frac{3}{4}$ inch in thickness, and are bolted together upon 2 blocks of $2\frac{1}{2}$ inches in thickness, leaving the portion from *c* to *d* open for the reception of the wheel *e*, and a small space is likewise left open in the body for the reception of the *seed*-cylinder, which is about 3 inches diameter and $2\frac{1}{4}$ inches in length. A small axle passes through the bed-frame and the cylinder, and this axle carries a small chain-wheel *f*. The principal wheel *e*, which is of very light construction and 18 inches diameter, carries also a chain-wheel *g* upon its axle of the same diameter as *f*, and the pitch-chain *f g* is stretched over the two wheels, by which means the progressive motion of the machine on the wheel *e* gives motion to the seed-cylinder on the axle of *f*. A seed-chest *b d h i* is raised upon the bed-frame; it is 12 inches long at bottom, and 24 inches at top, and the depth 12 inches, the width over all at bottom being 6 inches, and at top 10 inches. The chest is sometimes covered with a jointed lid, but this is not essential. A spout *k*, formed of sheet-iron, is attached below to the bed-frame, for the purpose of directing the seed to the furrow in which the machine is moving, and the legs *l l* are attached to the handles to prevent the latter from falling to the ground when the barrow is stopt. The pinching-screw *m* is applied to the purpose of adjusting a slider placed within the chest, for the more correct graduation of the discharge; and the slider is for this purpose armed

* Babbage on the Economy of Machinery and Manufactures, p. 102.

with a tuft or brush of bristles that comes in contact with the seed-cylinder. The entire fabric is generally of very slender and light construction.

(2306.) Fig. 385 is a longitudinal section of the barrow, on a scale of 1 inch

Fig. 385.



LONGITUDINAL SECTION OF THE HOPPER OF THE BEAN-DRILL.

to the foot. *a* is the bed-frame, broken off at both ends; *b* is the seed-cylinder, occasionally made of brass, but generally of hard-wood, which is grooved longitudinally, to receive and carry down the regular discharge of seed. The front and back *c c* of the chest are passed down between the stiles of the bed-frame at *d d*, which secures the chest to the frame; and *e* is the lid or cover of the chest. The slider *f* is mounted with the brush at *b* its lower end, which, by being made to approach to, or recede from, the cylinder, diminishes or increases the quantity of discharge; and it is held in any required position by the pinching screw *g*, which has freedom to move with the slider in the slit *i*; the spout *h* is here shewn also as broken off.

(2307.) Besides the method here exhibited, of driving the seed-cylinder by means of a pitch-chain, there are other modes of effecting the same purpose. One of these is by attaching short cranks to each end of the axles of the principal wheel and the seed-cylinder, the pair on each axle standing at right angles to each other; and a light connecting-rod passes from the one to the other on each side of the machine. This forms a very perfect communication of the motion from the principal to the minor axle, and is very certain in its operation, but it is more expensive than the pitch-chain. The same is also effected by employing two pairs of small mitre-wheels; but it is equally expensive as the cranks and connecting-rods. Common chain may also be adopted, along with acutely grooved pulleys; but the action of this is less certain than either of the others.

(2308.) An apparatus for sowing beans in drill is frequently employed, attached to one of the ploughs that are employed in giving the seed-furrow. It consists of a seed-cylinder, placed in a small case or frame, having an axle passing through the case, which last is surmounted by a small hopper to contain the seed. This apparatus is attached to the plough immediately behind and within the line of the mould-board, having a conductor, or spout, from the seed-cylinder to the bottom of the furrow, to conduct the seed to its bed. The motion of the seed-cylinder for the delivery of the seed, is produced in two different ways; first, the axle of the cylinder may be extended from the case to the land-side

handle of the plough, or tail of the beam, where it will have a bearing in which it turns round. Upon this extension of the axle, a light iron-loop or sheers is loosely fitted, about 2 feet in length, and in the sheers is placed an iron-wheel, of 18 inches diameter, whose axle is borne at both ends by the sheers. A grooved pulley is fixed upon the end of this axle, and a corresponding pulley upon the prolongation of the axle of the seed-cylinder, while a chain or band encircles the two pulleys. The iron-wheel, which is so placed as to run in the bottom of the furrow, will thus, when the plough is in motion, be made to revolve by its contact with the ground, and, through the pulleys and chain, will also cause the seed-cylinder to revolve and discharge the seed as the plough advances; and this will continue so long as the iron-wheel remains in contact with the ground. In order to produce a cessation of the sowing process, when required, a cord is attached to the hind extremity of the sheers, and is passed backward between the handles of the plough, till it comes within reach of the ploughman, who, by pulling the cord, and hooking it upon a stud provided for that purpose, raises the iron-wheel from the ground, and thus stops further motion of the seed-cylinder, and consequently the sowing process. When the plough has again reached the third furrow from the last sown, the ploughman relaxes the cord, when the wheel again settles down upon the ground, and the sowing process proceeds as before.

(2309.) The other method of giving motion to the seed-cylinder is accomplished by giving the extension of its axle a universal joint, and continuing the extension a few inches to landward of the landside of the plough, but without a bearing upon it. Upon this extremity of the extended axle the iron-wheel is placed, which in this case will be required of larger diameter, so that the axle may run clear of the tail of the plough-beam. By this arrangement the wheel will run upon the unbroken land. It will also require a stay of rope, or of light iron-rod, extending from a collar upon the axle, forward to an eye-bolt attached to the side of the beam, near the coulter-box. From the collar on the axle also a cord extends backward to the hand of the ploughman, whereby he has the same command over the wheel in this position for setting on and off the sowing process, as before described for the first method—the universal joint in the shaft serving in the present case the same purpose as the sheers in the former.

(2310.) An apparatus of the same description has been frequently recommended, and has even been partially acted upon, for sowing the white grains in drill. In these cases the grain is deposited, not in the open furrow, but on the furrow immediately preceding, and to complete the process, a harrow of three or four tines has been also attached to the apparatus to cover the seed. It is quite evident that the slowness of sowing the white grains by this method must ever preclude its being adopted on a farm of any extent.—J. S.]

51. OF SWITCHING, PRUNING, AND WATER-TABLING THORN-HEDGES.

" The seed-time closed, the fences, hedge and ditch,
Demand your tendance; first the ditches clear,
And then, with cautious hand, the hedges top,
Broad at the bottom, tapering by degrees,
As to the top the shears or bill ascend."

GRAHAM.

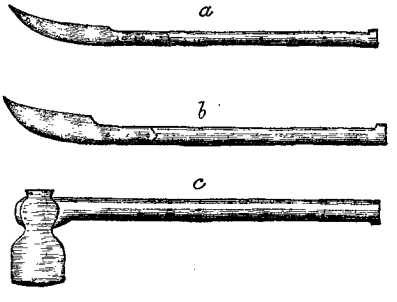
(2311.) Should a new line of thorn-hedge have been required on your farm, and been proceeded with during winter, as directed at page 373, and following pages, of the first volume, it will probably have engaged the hedger and his assistants all the time they could find available in the intervals between frosty, snowy, and rainy weather. It being a matter of real importance to the farm to have every hedge planted on it in the best manner, the freshest state of the weather should be chosen to execute the work; and should the hedger have been prevented proceeding with the planting by an obstructive degree of frost, snow, and rain, these same obstructions will have prevented him proceeding with his spring-work among hedges, namely, the pruning of the hedges themselves, and the scouring of the ditches in connection with them. Before the season advances too far, these latter operations should not be neglected; and rather than not have time to do *them* in their proper season, the planting of the new hedge should be discontinued for the season. It is possible, however, that the hedges may not require pruning, and the ditches scouring, every season: but, on a large farm, the probability is, that a little of either or both kinds of labour will be required every season, and especially at the early period of a lease.

(2312.) The first consideration which a hedge requires in spring, is its *pruning*. This, it will be observed, is an opposite injunction to that contained in the motto, which first prescribes the cleaning of the ditches; but, in truth, it would be an unseemly sight to see the *refuse* of a pruned hedge soiling the ditch below it, which had just been neatly scoured. Nor should the seed-time be brought to a close before the hedges and ditches are attended to in spring, as the motto would also have it; for the impulse of vegetation would be too active on the hedge-tree, its sap would circulate at too quick a pace to admit pruning to be then exercised with impunity. The sap should either be entirely quiescent, or in a sluggish state, when *pruning to any degree of severity* is exercised on a hedge; and to secure this state of the plant the operation should be

begun early in spring, but not till after the period of probably severe frost has passed away. I remember of a fine hedge, in Berwickshire, being breasted over, in a time of hard black frost, not so much for its own sake, as to obtain a near supply of thorns for a dead-hedge. I remarked to the hedger that the thorns gave a curious metallic ring on being struck with the hedge-bill; but he was insensible to the sound where he stood, which was beside the hedge. Whether this sound had any connection with the subsequent phenomenon exhibited by the hedge, I know not; but the pruned stems put forth very few buds in the subsequent spring and summer—not that they seemed to be dead by the appearance of the bark or of the wood, where this was exposed to view by the action of the hedge-bill. The hedge continued, of course, in a dormant state in the ensuing winter; but, in the following spring, more than twelve months after the pruning, it exhibited signs of life, and put forth most vigorous shoots in summer, some of them not less than 4 feet in length. Although I cannot explain this phenomenon, there is sufficient reason in it to justify the advice, that no hedge should be cut down in winter in frost, but rather to wait until the return of vegetable life in spring.

(2313.) The pruning of hedges consists of two operations, switching and cutting-down. *Switching* consists of lopping off straggling branches that grow more prominently from a hedge than the rest; and in doing this the extreme points of the other branches are also cut off. This operation is performed with the *switching-bill*, such as represented by *a*, fig. 386. It has a curved blade 9 inches long and 1½ inch broad; a

Fig. 386.



THE HEDGE-BILLS AND AXE.

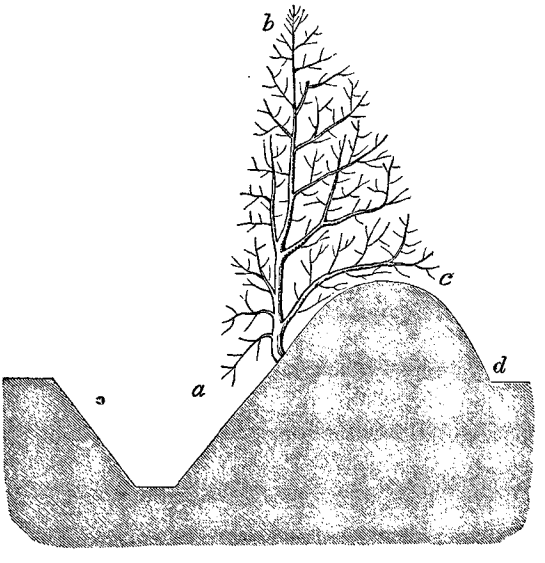
helve 2 feet 3 inches in length; and its weight altogether about 2½ lb. It feels light in hand, and is used with an upward stroke inclining backwards, something resembling a combination of cuts 3 and 6 of the cavalry sword exercise.

(2314.) Hedgers have a strong predilection to use the switching-bill. They will, without compunction, switch a young hedge at the end of the first year of its existence. No hedge ought to be touched with a knife until it has attained at least 2 years; because the great object to be attained by a new hedge is the enlargement of its roots, that they may search about freely for its support, and the only way it has of acquiring large roots is through its branches and leaves, which are the chief means of supporting the healthy functions of plants, or of even preserving them in life. Even beyond the age mentioned above, the pruning-knife should be very sparingly used, until the young hedge has acquired the height sufficient for a fence; and not freely then, but only to remove superfluities of growth, and preserve equality in the size of the plants. There need be no doubt of excessive pruning curbing the growth of the young roots of hedges, when we observe the very puny stems, which much pruned young hedges always present. Indeed, both experience and observation have satisfied me, that to abuse of pruning should be ascribed most of the deaths amongst *young* hedge-plants, and the consequent number of gaps observable in old hedges. No doubt the thorn plant is placed in a wide range of soil and situation, and it is reasonable to expect that it will grow better in some situations than others; but having had the good fortune closely to observe the rearing of thorn-hedges in a great diversity of soils, from the lightest gravel to the heaviest clay, and even in peat-moss, I can affirm that rational management will enable them to become a good fence, and continue so in any soil, though not in any situation, such as amongst water. Let the plant have peace to *grow* till it has acquired a considerable degree of natural strength—to acquire which state it will take a longer or shorter time according to the circumstances in which it is placed—acquiring it in the shortest time in deep sandy loam, the most *useful* of all soils, and taking the longest in poor thin clay on a tilly subsoil—let it, I say, have peace to *grow*, and let it be afterwards judiciously pruned, and I will give you the assurance of experience, that you will possess an excellent fence and a beautiful hedge in a much shorter time than the usual practice of hedgers will warrant.

(2315.) I have given, in fig. 387, a representation of the average height which a young hedge should attain, in relation to the height of its hedge-bank and the depth of its ditch, before it is switched up; and although the plants in that time will not have individually acquired the *strength* of that in the cut, still the form and extent of outline of hedge, as traced by the letters *a*, *b*, and *c*, may be obtained. This form is given to the plant by switching the face next the ditch with a slight batter

towards the top from *a* to *b*, which is more perpendicular, more like a walled fence than the face behind, from *b* to *c*, because the plant in that particular part is encouraged to cover the top of the hedge-bank with its lowest branches in order to prevent trespasses upon it, and to form a

Fig. 387.



A CORRECTLY SHAPED THORN-HEDGE.

sloping face from the level of the ground at *d*, to the top of the plant at *b*. A hedge of such a shape will not only have a broad basis from *a* to *c*, to form a close fence, but also a light top to take the lead of the upward growth of the plant; while the sloping face on each side affords room for the naturally upright, straight, stiff, spiny shoots to grow.

(2316.) A certain accident, however, may befall a young hedge in winter—it may be covered over with snow—and on the mass of snow subsiding by consolidation, many of the lateral branches of the young plants may be stripped off, and many of the top-shoots broken over. This accident I have seen, and there is no evading it, for the strongest branches of the largest hedge may be broken by the weight of snow. In such a case the young plants must be pruned in spring by the removal of all the injured parts, but no more. No matter though this necessary pruning leave the young hedge in an unequal state—some of the plants being much curtailed, whilst others have escaped injury—let it grow;

and though the pruned plants may not overtake the rest, these latter can be pruned to a proper size one year earlier than they would have been, had no accident befallen the hedge.

(2317.) With regard to pruning hedges of older date, there are usually two forms of hedges found on a farm, in Scotland. One is the pointed or hog-mane shape, as shewn in fig. 387; the other is a more natural form assumed by the plants, on having leave to shoot up their tops, whilst the lateral branches are switched off. Though these two forms are also found in England, in that country of luxuriant hedges other forms are met with, many picturesque in the extreme, but otherwise not desirable, inasmuch as large expanded tops occupy much valuable ground. Were such a broad-topped form allowed in some parts of Scotland, the first winter's snow would inevitably crush the hedge down to the ground. Of the two forms referred to, namely, the hog-mane and natural methods, either may be adopted according to circumstances. Along both sides of a turnpike road, the low hog-mane is most advisable, to allow free circulation of air to the road. A height of from 4½ feet to 6 feet will suffice for the purpose. The natural method is admirably adapted to afford shelter, and should therefore be reared against the stormy quarter of the farm; and, as pruning is attended with trouble and expense where hedges thrive luxuriantly, they may be allowed to grow up where they cannot do harm, such as on the tops of heights and in hollows. After having attained its natural height—which, in a hedge, may be 10 feet, the thorn plant acquires thickness of stem, and if let alone will continue to increase for many years; but while the stem becomes thicker, the plant changes its character, gradually forsaking the form of the hedge-plant, and assuming the more natural form of the tree—enlarging its head by the lateral expansion of the upper branches, and increasing its stem by a natural pruning of the lower ones—every year thus rendering itself more and more unfit for a fence. In observing this natural tendency in hedges, the hedger should learn, that the thorn-plant is not in its natural position when placed as a hedge in a line along the side of a field; and, consequently, if he desires to retain it still as a fence, he must curb its tendency to become a tree. He may even make it resume its youthful habits, by well-timed pruning, and by the remarkably accommodating nature of its character.

(2318.) The only sort of pruning applicable to such a case is cutting down the hedge, and there are two modes of doing this, one by leaving the stems and branches at a certain height from the ground; the other by cutting off all the branches and the stems to within a few inches of

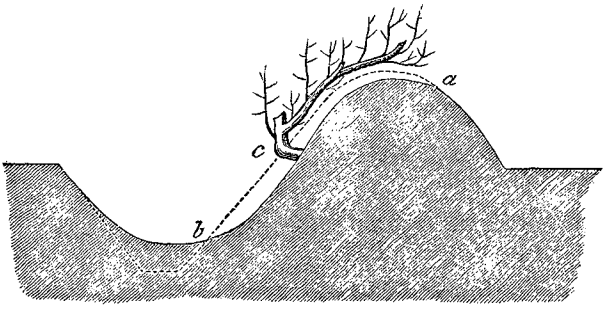
the ground. The first mode of cutting a hedge is called *breasting it over*, the second *cutting it down*. The former is done when the stems can be cut over with a light hedge-bill; the latter requires a heavy bill or the hatchet.

(2319.) The instrument with which a hedge is breasted over is called a *breasting-knife*, and it is very like the switching-bill *a* in fig. 386; but the blade is somewhat shorter and stronger, and the bill is, of course, altogether heavier. It is used with a back-handed upward stroke, very like cut 3 of the cavalry exercise. It costs from 3s. to 7s. 6d.—say 5s. On making this diversified statement of prices, I may remark, that the diversity arises solely from the difference of quality in the article. The common English hedge-bills, *made for sale*, cost only 3s. a-piece; but the probability is, that a good day's work cannot be got out of 1 in 10 of these instruments; whereas, the Scotch-made 7s. 6d. bills will last for years, give satisfaction all the time, and prove themselves *cheapest* in the end.

(2320.) On determining to *breast over* a hedge, its stems should not be stronger than what a hedger can cut through by one hand with two or three strokes of the breasting-knife. The hedger, on commencing this operation—using the knife with his right hand, and covering his left with a stout leather-glove—stands on the hedge-bank, in a line with the hedge, with his face outwards, that is, with his right hand to the hedge to be cut down. After cutting a few thorns at the end of the hedge, to make room for himself to stand upon, he commences cutting the principal stem or stems from one root, at about the height of his knee above the ground out of which they are growing. In cutting, he uses the knife in this way: First making a firm cut upwards upon the stem, the knife may penetrate into its heart, or, if it is not much exceeding 1 inch in diameter, may cut it through at one stroke; but the generality of the stems will require more than one stroke, though I have seen a hedger, of by no means great personal strength, cut through far thicker stems at a stroke than his appearance would indicate. But suppose the first stroke penetrates about an inch, the next one is given from above to meet the inner end of the first one, so that a wedge of the stem may be cut out; this flying off, the next stroke is given in the exact line of the first, and it will most probably sever the stem; but if not, a stroke at the furthest corner of the cut, and another at the nearest, will send the knife through. The cut stem will either drop down on end upon the ground behind the line of the hedge, or it will be kept suspended, by the interlacement of its branches amongst those of the plant beyond it. All the cuts made with a view to remove the wedge-shape pieces are compara-

tively light; but all the upward cuts intended to sever the stem are given with force, and both kinds of strokes follow one another as fast as possible, until the stem is cut through. In renewing the strokes, the left hand is ready, the moment the knife is brought back, to receive its back between the fingers and thumb, as a rest. On the stem being severed, the hedger seizes its lower end with his gloved hand, and with the assistance of the knife in the other, pulls it asunder from the adjoining plant, and throws it endways either on the head-ridge beyond the ditch beside him, or upon the head-ridge of the field behind the hedge-bank; whichever may be the place selected for the future dead-hedge. Standing up at the far side of the sloped cut of the pruned stem, there may be a small splinter of wood left by the last stroke of the bill, though with a dexterous cutter this seldom happens; yet to give the cut a finished appearance, the hedger cuts off the standing up splinter with his bill, held by both hands. All the lateral branches growing from the stem are cut off in the same manner as far back as the top of the hedge-bank, with an inclination corresponding to the slope of its face, so that the backmost branch preserves about the same height above the top of the hedge-bank as the stem in front is above the hedge-line. The finished breasting may be seen in fig. 388, where the sloping cuts are shewn from *c*

Fig. 388.



A BREASTED OVER THORN-HEDGE, WITH THE HEDGE-BANK WORN DOWN.

upwards. Many of the branches will have been cut through with one stroke of the bill. The hedger proceeds in this manner until the entire hedge is cut down. The cost for breasting over a hedge is about 4d. per rood of 6 yards. If the stems, such as at *c*, are strong and hard, the cutting-bill, afterwards described, may be used for the stems, and the breasting-knife for the branches. A pair of hedger's gloves costs 1s. or 1s. 6d.

(2321.) Breasting is best suited to a comparatively young hedge,

every branch and stem of which will soon be covered over with young twigs, that will form a close structure of vigorous stems; but an older hedge, one that has reached its utmost natural height of 10 feet, when cut down should not be breasted over, as is too often done, but literally cut down within a few inches of the ground. In effect, this is a very different operation from breasting, inasmuch as it leaves no branches, and only a small portion of the stem.

(2322.) The instrument used for this purpose is the *cutting-bill*, seen at *b* in fig. 386. It has a blade 7 inches long, and 2½ inches broad; a helve 2½ feet in length; and the bill altogether weighs 6 lb. It is used exactly in the same manner as the breasting-knife, but being so much heavier in itself, and employed on stronger plants, it requires, of course, greater labour to wield it. It costs 7s. 6d., the highest price of such instruments.

(2323.) In cutting down an old hedge with this bill, the strokes are still given upwards, but near the ground at first; and to give freedom to the hedger he first uses the breasting-knife to clear away all the small branches that grow out of and around the stem to be cut through. Without this precaution the operating hand of the hedger might be severely lacerated by the straggling branches. The stem being thick, many strokes will be required to cut it through, and many of these will have to be given downwards to cut away the wood in wedges. When severed, the stems are laid regularly on the ground, on either or both sides of the hedge, as the thorns may afterwards be required. The cost of cutting down an old hedge is 2½d. per rood of 6 yards. It is cheaper than breasting, because there is only one stem to cut through to remove the entire plant.

(2324.) A still older hedge, with stronger stems, should be cut down with the light *hedger's-axe*, which is seen at *c* in fig. 386. It weighs 3 lb., and its helve measures 3 feet in length. It costs from 1s. 8d. to 2s. 6d. ranging in size from No. 1 to No. 4. In using it, the hedger goes in the opposite direction to using the breasting-knife and cutting-bill; he goes with the left hand next the hedge, and uses the axe with both hands, and must direct its strokes as he would a carpenter's common axe. The twigs are first removed by the breasting-knife, the cutting strokes are all made upwards, and the obstructing timber is wedged out in pieces.

(2325.) Hedges are wofully mismanaged in the cutting in many parts of the country. Without farther consideration than saving the expense of a paling to guard a new-cut-down hedge, or in ignorance of the me-

thod of making a dead-hedge from the refuse of the old, the stems of an *old* hedge are often cut over about 3½ feet high, to continue as a fence. The consequence is just what might be anticipated from a knowledge of the habits of the thorn, namely, a thick growth of young twigs where the hedge was cut over, the ultimate effect of which is, a young hedge standing at 3½ feet above the ground upon bare stakes. The wise plan, therefore, to preserve the value of the old hedge is to cut it near the ground, and form a dead-hedge of the part cut off.

(2326.) But another form of mismanagement is shewn in the mode in which the cuts are made when hedges are cut down. The bill is too often used to *hack down* the *stems*, instead of to *cut off* the *branches;* and the consequence is just the opposite of what should be, namely, the branches, worthless when severed from the hedge, are cut off clean, while the stems, upon which depend the future fence, are split and hacked to pieces on the top. Fortunately for the owner of the hedge, the natural habit of the plant counteracts the mischievous tendency of his own ignorance. Hacked and hewed as the stems are, they nevertheless push out young twigs, and conceal the injury they have received at the hand of their owner. This barbarous work is occasioned by giving a downward instead of an upward stroke in cutting off the branches and stems. The difference in the strokes in cutting a hedge is thus very well explained by Mr Francis Blaikie. "A moment's reflection," he says, "will shew that it is impossible for an edge-tool to pass through a piece of timber without causing a severe pressure against one or both sides of the wood, because the tool occupies *space*. The teeth of a saw drags the chips out of the cut, and *give the space* requisite for the tool to pass, but an edge tool can only pass by pressure. . . In cutting the stem of a hedge or young tree which is growing upright, if the blow is struck *down*, nearly the whole pressure falls on the stub or *growing stem*, which is *shattered to pieces*, while the stem cut off is left *sound;* but when the blow is struck *up*, as it should always be, the effect is reversed, the *stub* is then left *sound* and smooth, is cut *clean*, and the *stem* cut off is *shattered*." The advantage of the proper method is, that "When this latter practice is adopted, the wet does not penetrate through the stub into the crown of the roots, canker is not encouraged, and the young shoots grow up strong and healthy, and able to contend against the vicissitudes of the weather."* The cuts on the growing stems are made by the hedger not in the plane of the line of the hedge,

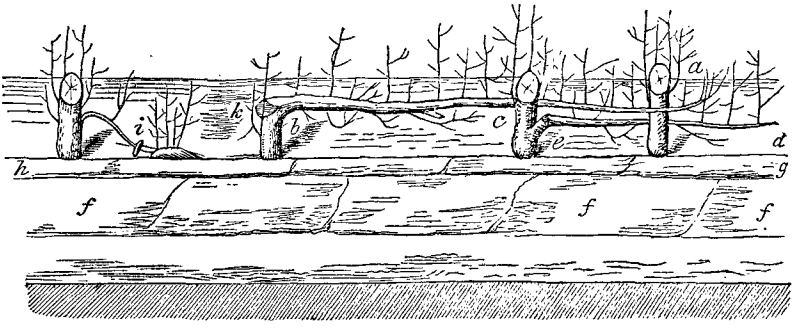
* Blaikie on Hedges, p. 33.

but at a considerable angle to it; so that, if the cuts are attempted to be viewed in the direction in which the hedger proceeds in cutting, they will not be visible, while they will almost face the spectator in the opposite direction.

(2327.) Hitherto the pruning and cutting have proceeded, on the supposition that the hedge cut down would make a sufficient fence when it grew up again; but this will not be the case if many of the stems are so far asunder as to leave gaps between them, even after the young twigs shall have grown. In such a state the pruned hedge will never constitute an efficient fence without farther assistance; and the mode in which assistance is rendered is by what is termed *plashing*, that is, laying down a strong and healthy stem across an opening which would otherwise form an irreparable gap in the hedge. When, on cutting down, the hedger meets with a gap which he sees will never be filled by the ordinary growth of the hedge, he leaves a healthy supple plant standing either beside or near it; and all such stems he leaves on the same side of a gap, that when plashed, they may all lie in the same direction. After the hedge is all cut down, the hedger plashes down the stems he left standing, and this he does in the following manner:—Commencing at the end of the hedge where he began to cut, he first prunes off all the branches and makes an upward cut in the stem near the ground, on the side opposite to the direction towards which the stem is to be plashed, but no deeper than is necessary to bend it to the proper position, which should be as near to and parallel with the ground as may be; because there is no use of plashing, unless the stems are laid so close to the ground as to fill up the gap from the bottom. The plashed stem is partly kept down by a snag on the neighbouring stem, or by twisting it before and behind others, or by a hooked stick driven into the ground near its point, and partly by a wedge thrust into the cut of its stem, and clayed up from rain and air. The plashed stem is cut over, of the length required for the particular gap. The breasting-knife is used in plashing. Plashing may be seen in fig. 389, where *e d* is the first plashed stem, cut nearly through at *e*, and laid along near the ground, across the gap which extends beyond the cut; and where *b a* is another stem passing across the large gap from *b* to *c*; *k* is the wedge of wood thrust into the cut of the plashed stem *b a* to keep it down. The stem *b a* extends beyond the immediate gap from *b* to *c*, if there is no means of fastening it down at *c*, and its end is brought in front of the pruned stem *a*; but should there be a means of fastening, then the stem should be cut off at *c*. It will also be observed, that the stem *e d* originates at *e* and not at *d*, though the gap is really beyond *d*, and not between the stems *c* and

a, on the supposition that no young stem was found at *a* to leave, but

Fig. 389.



THE PLASHING AND LAYING OF AN OLD HEDGE, AND THE WATER-TABLING OF A DITCH.

should there be, then of course the plashed stem *e d* should have originated at *a* and extended across the gap beyond *a d*.

(2328.) Plashing of hedges is much practised in England, and where it is frequently very neatly executed; but I cannot help thinking that many a good hedge is there needlessly cut down for the mere sake of being plashed. There, plashes are laid at all possible angles, and twisted into all possible forms, as if to show that the thorn plant will outlive every possible ill-usage. I cordially agree with the following sentiments on the practice of plashing—a practice which I always dislike to see, and for which I am convinced there would be no necessity if hedgers would regard thorns in the light of other plants, and endeavour to *preserve* the life of every plant in a hedge, instead of relying on the possibility of tormenting one plant into a substitute for another whose death was occasioned by his own mismanagement. This is the history of the origin of most of the gaps to be seen in hedges. "Plashing an old hedge," says Lord Kames, "an ordinary practice in England, makes, indeed, a good interim fence, but at the long run is destructive to the plants; and, accordingly, there is scarcely to be met with a complete good hedge where plashing has been long practised. A cat is said among the vulgar to have nine lives. Is it their opinion that a thorn, like a cat, may be cut and slashed at without suffering by it? A thorn is a tree of long life. If, instead of being massacred by plashing, it were raised and dressed in the way here described, it would continue a fine hedge perhaps for 500 years." * To see small young twigs proceeding from a thickly plashed hedge is to be reminded of these lines,

* Kames' Gentleman Farmer, p. 283.

——— " hedges even-pleached—
Like prisoners wildly overgrown with hair,
Put forth disordered twigs."

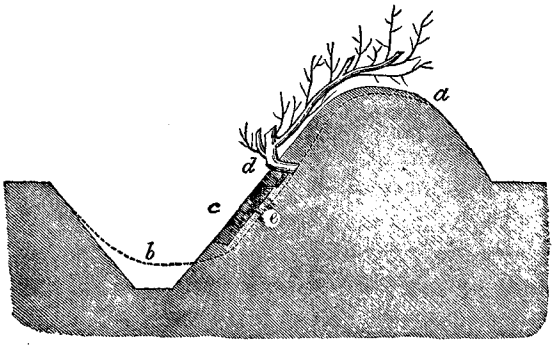
HENRY V.

(2329.) So much for hedges in spring; come we now to the *ditches.* A ditch which conveys a pretty constant stream of water may have so much mud deposited in it as to require scouring before the roots of the hedge beside it shall be able to contain all the matter that should be scoured out. In such a case, as much mud should be placed between the hedge-roots as can conveniently lie, and where it will answer the double purpose of affording an easy mode of getting quit of part of the mud, and of doing good to the hedge by thickening the soil around its roots, and the remainder may be removed at leisure for other purposes.

(2330.) But the more usual practice is, that when the ditch is to be scoured out in a thorough manner, the hedge is at the same time pruned, and the hedge-bank trimmed; and the necessity for combining the work will be rendered obvious from the following considerations. After the process of weeding hedges has been conducted for some years by removing the grass from the side of the ditch, and the weeds as they spring up in the face of the hedge-bank, the earth about them will be removed below its original level, especially in friable soils, and indeed in all soils. The incessant action of the atmosphere, and of rain and snow occasionally upon the inclined surface of the hedge-bank, will sensibly assist the weeding to remove the soil from the roots of a hedge. The combined consequences of these causes are, that in time the roots are left too bare, and which deficiency, if not remedied, will cause the whole hedge to be shaken to the roots by every moderate degree of wind. By looking back to fig. 388, it will be seen that the soil has been removed from the hedge-bank, and the bottom of the ditch filled up to the extent indicated by the dotted line *b c a*, from the midst of which the root of the hedge is seen projecting at *c*, as far as if it had originally been planted projecting from the bank. The defect can be easily supplied, and the mode by which it is done is called *water-tabling*, which is this:—After the hedge has been breasted over or cut down, for it should be borne in mind that water-tabling can only be executed in the *best* manner after the hedge has been thoroughly pruned, the hedger, now transformed into the ditcher, makes a sharp notch with the spade, 3 inches deep, in the side of the ditch, about a foot below the root of the thorns, as at *c*, fig. 390. He then pares away all the earth to that depth from below the thorn-roots to the notch, preserving the proper inclination of the side of the ditch. If the side of the ditch is found worn away to a greater depth than the required paring, earth should be rather put on than taken away from below the

root of the hedge, as seen between *e*, the dotted line, and the sods *c* and *d*. In the mean time the hedger's assistant—for the work is most expeditiously and better done by 2 men than 1 in proportion to the number, though the hedger can do all the work himself—the assistant raises sods

Fig. 390.



THE MODE OF WATER-TABLING A HEDGE-DITCH.

from the best part of the bottom of the ditch, 9 inches broad, 4 inches thick, and of a convenient length, and lays them aside for the hedger. The hedger then places these sods with the spade upon their edge on the notch, with the grass side outwards, and beats them to the bank with the back of the spade, making them all of the same width by paring their upper edge with the spade, and keeping it in a straight line, as seen at *c*, fig. 390. These sods will unite to each other the more quickly and firmly that the edges are made to join a little acute angled instead of square, as better seen at *f*, fig. 389, which represents the face of the sod as set. The reason for putting the grass side of the sods outwards is, that the sods may adhere and grow to the bank; for if put with the grass side inwards, the frost of the ensuing winter getting between the grass and the bank, would cause the sods to slide down; and there need be no apprehension of injury to the hedge from the growth of the grass when the sod is set so far below the hedge roots. This sod is called the *set-sod*. While the hedger is engaged in setting these sods, the assistant raises other sods, 6 inches broad, 4 inches in depth, and of a convenient length. After a few of these smaller sods have been made ready, the hedger lays them, with the grass side downwards, upon the edges of the set-sods, beating them flush with the face of these, and pushing them under and as if to support the thorn roots with them. These are seen at *d*, fig. 390, and in edge at *g h*, fig. 389, and are called the *table*. The reason for placing *their* grass-side downwards is obvious,

otherwise the grass upon it would spring immediately among the roots of the thorns, and there would be no method of removing the grass without frustrating the very purpose for which the water-tabling was performed, namely, the restoration of the earth to the thorn roots. On the hedger proceeding with the table, the assistant throws the parings of the sides and bottom of the ditch upon the hedge-bank, immediately behind the table-sod, and among the thorn roots, to fill up the vacant space that would otherwise be left there. This filling up is seen from *d* to *a*, fig. 390, and from *d*, fig. 389, along the line *d*, *e*, *c*, *b*, *k*, *i*. Water-tabling alone costs 2d. per rood of 6 yards.

(2331.) Water-tabling renovates the growth of thorns, re-establishes their hold of the bank, that no wind can shake them to their roots, and encourages the growth of shoots around the incised parts of stems and branches. Water-tabling cannot be performed where thorns have been planted on a scarcement, because this prevents the mouldering of earth; but this advantage, such as it is, is more than counterbalanced by the encouragement which a scarcement affords to the growth of weeds, as I have already explained in (618.), and shewn in fig. 45.

(2332.) It is possible in the oldest hedges, when cut down, there may be gaps of such width, and so few stems fit for plashing, that other expedients should be adopted to fill them up, and two such present themselves to notice; one to *lay* young shoots from the old stems into the gaps; and the other is, to fill up the gaps with young quicks. The laying of the shoots cannot be accomplished in the same season with the cutting down of the hedge, nor until they are pretty long; but young quicks may be planted immediately after the water-tabling is finished.

(2333.) In planting young quicks amongst old thorn roots, it will be necessary to remove all the old earth in the gaps, and spread it behind and between the old roots where there are no gaps. New and fresh earth should be prepared for the purpose, by mixing mould, decayed vegetables, and lime together in a compost, and, when ready for use, put into the places formerly occupied by the old earth. The young thorn plants should be prepared as shewn in fig. 41; and on the bed being formed for them in the new compost earth, in the line of the old hedge, let them be laid upon rotted farm-yard dung in the manner represented in fig. 42; let the earth be brought over the dung and plants and beaten down; and should the weather prove dry, or likely to be dry, let them be well watered. The young plants will grow; and to preserve them from all annoyance, in summer, let any twigs springing from the old stems that interfere with them, be pruned away.

(2334.) The *laying* of young twigs is managed much in the same way.

The old earth is removed from the gaps, substituted by the compost, and a stout twig brought down from the stem, on each side of the gap, cut short and notched, and held down amongst well-rotted dung by a hooked stick, and lastly covered over with earth. This process is attempted to be represented in fig. 389, where *i* is the laid twig from the old stem *h*. After the layer has fairly taken root, and the young plant growing with vigour, its connection with the old stem may then be severed. It is obvious that this plan of filling a gap is only advisable when a single stem from each side is able to fill it up; if not, quicks should be planted.

(2335.) I observe that some farmers remove the hedge-bank behind a thorn-hedge, to make compost of; but such a practice is highly injurious to the hedge, even after it is grown up, by exposing its roots, which chiefly lie under the bank, to cold and frost. If a hedge is cut down whose bank has been treated in this manner, and no means used to protect the roots when exposed on the removal of the branches, it is possible that a few nights of severe black frost may kill every root that lies nearest the surface. I have no doubt that particular plants of old hedges are killed in this manner, without the cause being suspected by the farmer. When the hedge-bank has been thus removed, and the hedge cut down, provision should be made to protect the roots by a covering, and it is accomplished by the scouring of the ditch. If the ditch, scoured to its usual size, cannot afford sufficient materials to answer the purpose, it should be made larger. A low backing of turf, obtained either at hand or brought from a distance, will make a neat hedge-bank, and save a good deal of earth. The cutting down of the old hedge, water-tabling it, scouring the ditch, building the backing of turf, and filling up the hedge-face and bank with earth, may all be done for from 8d. to 1s. per rood of 6 yards, according to the tenacity of the soil.

(2336.) The *buds* of the young hedge that was planted in the early part of winter, will shew symptoms of life early in spring, and the first symptom of strength shewn, other than the actual exhibition of the buds themselves, is their action upon the earth that may happen to cover them, which becomes blistered, and at length is broken off. Whenever the blistering is observed, assistance should be afforded the young buds to break their prison bonds, by removing the earth with the finger or with a small piece of stick, after which they will soon burst into leaf.

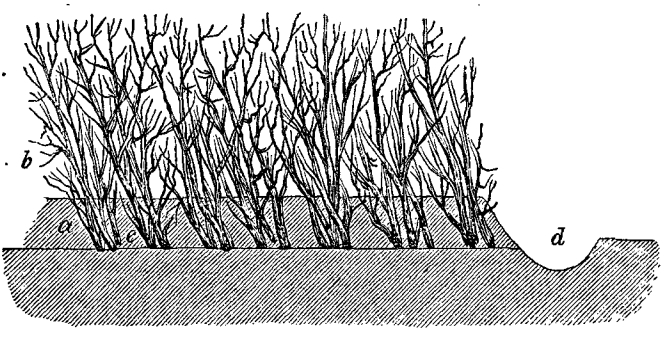
(2337.) When it is determined to cut down or breast over any hedge, the operation should not be done at random in any season or year. I have already said that it should not be done in the depth of winter, nor should it be done when inconvenient for grass fields adjoining. It

should never be done when any of the adjacent fields are to continue in grass, or about to come into grass; the time chosen for it should rather be when they are going out of grass; for hedges being specially intended for fences against stock, it would be absurd to remove them when they would be of use in that respect. Still it will scarcely be possible to avoid transgressing in regard to one field or another on the removal of a hedge, for it rarely happens that two fields of which a hedge forms a mutual fence, both will be in the same position of the rotation, and in case of old grass-fields, it is not possible to avoid it; so that the most that can be studied to accommodate any case, is to avoid cutting down the hedge as long as the field in which it grows continues in grass, whatever may be the state of the field immediately behind the hedge; except when that field is in old grass. The compromise that takes place between the two fields is this,—that when the hedge in one is cut down on its going out of grass, the thorns thus furnished should be made into a dead-hedge to fence the other, and this is the usual practice; and when a mutual hedge is removed between two grass-fields, a temporary fence is required for both fields.

(2338.) After the hedge has been pruned, as you have seen, let us now proceed to construct a *dead-hedge*. A hedger and an assistant are necessary to construct it, and it is done in this manner:—The assistant cuts the severed stems of thorns into pieces of about 3 feet in length with a cutting-bill or axe, according to the strength of the stems, and when these are very thick, they had better not be employed for this purpose, and the branches which they afford only lopped off and used. He lays one piece above another, until a bundle is formed that he can easily lift from the ground, taking care to add small twigs to it to thicken its appearance, and to compress it with his foot, which should be shod with a hedger's clog, that the pieces of the bundle may adhere to each other. He thus makes one bundle after another. The hedger meanwhile takes his station on the line chosen for the dead-hedge to occupy, which is either immediately behind the hedge-bank, or 1 foot from the edge of the ditch in front of the hedge, according to the side on which it is intended to fence the hedge just cut down. The dead-hedge, if placed behind the hedge, should not be set upon the top of the hedge-bank, as cattle and horses would reach over it, and crop the shoots of the new pruned hedge as they get up; it should occupy the foot of the hedge-bank. It is a matter of some importance to construct a dead-hedge so as not to be affected by the prevailing winds of the locality, otherwise it may be much torn and even upset by a high wind. For

this reason its head should slope in the direction the dreaded wind blows. The first thing done by the hedger towards the formation of the dead-hedge, is to lay a spadeful of earth against the fence from which the dead-hedge is to run, as at *a* fig. 391. The trench made in the earth

Fig. 391.



THE DEAD-HEDGE OF THORNS.

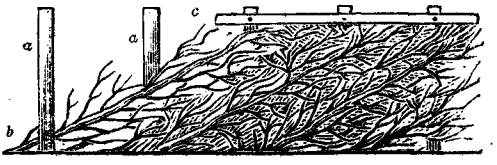
should be as large as easily to admit the lower end of the bundle of thorns, as at *d*. The first spadeful thus laid up, at *a*, forms a lean to the first bundle *b*. When the hedger is ready with the trench, his assistant hands him a bundle with a long-shafted fork, which enables him to reach over the top of the breasted hedge. The hedger receives the bundle with his gloved hands, and places its butt-end *e* into the trench, and pushing it from him with his clogged-foot, makes the head lie away from him, as towards *b*. A tramp of earth is then raised with the spade, and placed against the butt-end of the bundle, as on *e*. Thus bundle after bundle is set up firmly by the hedger, and after a few yards have been thus set up, he cuts in all straggling stems with the breasting-knife, and chops the top and outside of the bundles into a neat form of dead-hedge, having a perpendicular side and a flattish head. All the thorns of a strong hedge will not be consumed by the dead-hedge, so they can be applied to other purposes. The figure does not represent the dead-hedge in so massive a form as it really has.

(2339.) Amongst other purposes, thorns have been used to fill drains; but it is obvious, from the *nature* of the material, however durable thorns may comparatively be as a wood, its utility for such a purpose, which should be a permanent one, is quite misplaced. Thorns may answer a temporary purpose in this way, but no landlord should tolerate such a mode of filling drains on the part of the tenant. He should either oblige the tenant to make substantial drains, when he makes them at all, or

he should himself assist in making them, which is the better plan of the two, as I have already shewn in (1096.).

(2340.) Another form of dead-hedging is by *stake-and-rice*, and it is formed of the branches of forest-trees; and where these are plentiful and thorns scarce, this is an economical mode of making a dead fence. Its structure is very well shewn in fig. 392, where *a a* are stakes fashioned

Fig. 392.



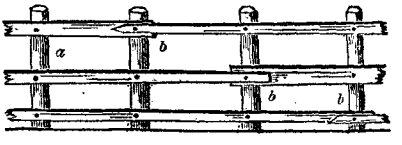
THE STAKE-AND-RICE DEAD-FENCE.

from the longer branches of the tops of trees; or, should the tops be too small to afford sufficiently strong stakes, they should be procured from sawn timber, 4½ feet in length, and about 4 inches in the side, and after being pointed, driven into the ground at from 4 to 6 feet asunder, according to the length and strength of the tops. The tops *b* are then set on their butt ends on the ground, at an inclination of about 45°, and wound alternately before and behind the stakes as far as each top reaches. The same principle, which determines the inclination of the bundles of a dead-hedge, namely, along the direction of the heaviest winds, is followed in setting the tops of stake-and-rice. A neat and stout finish is given to stake-and-rice, by nailing a single rail of paling along the top of the stakes, as at *c*. Any sort of brushwood, provided it reaches from stake to stake, will answer for stake-and-rice; and, if the brushwood is short, the stakes can be set the closer together.

(2341.) Such a species of fence requires fewer nails, and less good wood, than an ordinary paling, and is therefore cheaper, and it will stand an equal length of time, as the stakes have less strain upon them, and they have not the same weight of materials to bear. The branches being warped before and behind, protect the stakes from many accidents to which paling is liable; such as people climbing over them, swing-trees catching along them, cattle and sheep rubbing against them. Stake-and-rice forms an excellent fence and shelter for sheep from any blast behind its matted texture; and on this account it should be placed on the northern and western sides of fields, whence the strongest winds prevail. There is only one objection to it, arising from its close structure, which rendering it liable to lodge snow that would find its way through the rails of a paling, it is apt to be crushed by its weight.

(2342.) A very common dead-fence for protecting hedges and grass from stock in spring and summer, is the common wooden *paling*. It is represented by fig. 393. If tall-grown Scots fir, 8 inches in diameter, can be procured at no great distance, or are grown upon the property of which the hedges are to form a fence, better materials for temporary fencing of young thorn-hedges need not be desired. Trees of that size will cut up into deals, which besides the outside slabs, will divide up the middle for rails of perhaps 24 feet in length. The same trees, quartered, will make stakes, which, if cut off at 4½ feet in length, and pointed, are fit for use. Weedings of plantations, either of Scots fir or larch, are also very convenient for cutting up into paling, either entire or sawn up the middle. Stakes as *a* should be driven by a mallet, fig. 218, 15 inches into the ground at 5 or 6 feet asunder, and, when hardened, the ground is opened by the foot-pick, fig. 37, or driver, fig. 219; and they will support a fence of 3 feet 3 inches in height. Two rails are sufficient to fence cattle, but three are required for sheep. To give additional strength to the fence, the rails should be nailed on the face of the stakes next the field, and made to break-joint so that the ends of all the three rails shall not be nailed on the same stake; nor should the broad ends of the rails be nailed together, even though thinned by the adze, but broad and small ends as seen at *b b b*, on different stakes, in order that the weight and strength of the rails may be equalized upon them. To make the paling secure, there must be a short stake driven behind and a stay-rail nailed to every third stake. The upper rail should be nailed near the top of the stakes, the lowest edge of the lowest one 6 inches above the ground, and the upper edge of the middle one 20 inches from the ground. A paling is set up in the same places as a dead-hedge. The best nails for paling are what are called "Scotch made stout paling nails," from 3 to 3½ inches long. Such a paling, where wood is not scarce, costs 1s. 2d. per rood of 6 yards. In the Stewartry of Kirkcudbright wood is so cheap, that a paling of 4 rails, with stakes at every 4 feet, can be put up for 9d. or 10d. the rood of 6 yards; and, I dare say, so it may in the interior of other parts of the country where wood is plentiful. Charring the points of the stakes, for paling or stake-and-rice, no doubt incurs some additional expense, but it renders them much more durable.

Fig. 393.



THE COMMON WOODEN PALING.

(2343.) Lord Kames says, and there are farmers who seem to adopt

the opinion, that "the hedge is fenced from cattle on the one side by the ditch; but it is necessary that it be fenced on both sides. The ordinary method of a paling is no sufficient fence against cattle; the most gentle make it a rubbing-post, and the vicious break it down wantonly with their horns. The only effectual remedy is expensive; but better no fence than one that is imperfect. The *remedy* is *two* ditches and *two* hedges, with a high mound of earth between them."* We are left to infer from this that a paling is not sufficient protection to a hedge, but that two ditches and a mound are, and other writers promulgate the same opinion. It is surprising to hear persons acquainted with stock asserting that any ditch of ordinary dimensions, connected with it, can protect a hedge against them. When such a notion prevails amongst farmers and landed proprietors, no wonder that thorn-hedges are frequently seen in a ruinous state. Surely if a *good paling* is no protection, much less will a small *ditch* and mound be. Where two ditches are formed, they require as much paling as a single hedge, before and behind, besides the disadvantage of taking up a larger space of ground; and if gaps cannot be prevented in hedges but by double rows of thorns, they must be negligent hedgers indeed, that have the management of them. The truth is, a fence, of whatever material it is made, is absolutely necessary on *both* sides of a young thorn hedge, when that hedge separates fields that are pastured; and of what material that fence may be constructed depends, of course, on the facility with which it may be obtained.

(2344.) The only disease incident to young hedges in spring is *blight*. It is occasioned by the sudden evaporation of hoar frost, in a calm atmosphere, from the young leaflets of the hedge, by a powerful rising sun. The sudden evaporation causes so intense a cold as actually to destroy vitality in the tender parts of the plant which have just burst into leaf, and the consequence in a few days afterwards is seen, in the young leaves and tender shoots bearing the appearance of having been severely scorched by fire. I have frequently observed this scorching, to a partial extent, on the *east* sides of hedges that run north and south, the side next the rising sun; but in spring 1841, the affection was so severe and extensive, that not hedges only suffered, but large beech-trees of upwards of 100 years old, that came early into leaf, literally died in the ensuing winter. A hedge so scorched will be leafless all summer on the part scorched, and if the autumn is favourable to vegetation, may put out a few feeble shoots, which will easily be destroyed by severe frost in winter. Next season, however, more vigorous shoots will appear, and in the end the hedge may recover the severe check it has received, and it will feel it the longer the younger the hedge. I need hardly caution you not to allow a hedge so affected to be switched until it has perfectly recovered.

* Kames' Gentleman Farmer, p. 278.

52. OF HIRING FARM-SERVANTS.

"*Touchstone.* ——————— thou art raw.

Corin. Sir, I am a true labourer; I earn that I eat, get that I wear; owe no man hate, envy no man's happiness; glad of other men's goods, content with my harm; and the greatest of my pride is, to see my ewes graze, and my lambs suck."

AS YOU LIKE IT.

(2345.) *Married* farm-servants are usually engaged for the year, and the period at which they are engaged is the beginning of March. This season of engagement is in every respect favourable to the servants, but not for the masters. The servants are thus secured in their new service long before the term of departure from the old, and the engagement being made early in spring, enables them to put the summer crops into their new gardens, possession of which is given them at that early period. On the other hand, the disadvantages attending so early an engagement to the masters are, that having secured another service, indifferent servants have a temptation to perform their work for the future in a slovenly manner, and malicious ones have a long time to wreak vengeance against their masters in the ill-treatment of their horses. Good and conscientious servants will be guilty of no dereliction of duty, even in the prospect of leaving the situations they like; but then such servants are seldom parted with. Various are the circumstances which cause a separation between master and servant. The servant may become unable for the work he has long performed; his wife may be a troublesome person, and this is not an unfrequent cause of a man being obliged to leave a good place; his family may be guilty of many peccadilloes, in despite of their parents' injunctions; the man himself may have a peevish temper, and desire a change. On the other hand, as regards the farmer, an unpleasant son may succeed a judicious father; he may be unreasonable, and frequently find fault without much cause, an injustice which a well-disposed servant cannot long endure. As no perfection can be found in either master or servant, it is obviously the interest of both to exercise mutual forbearance; the master should overlook many failings, provided he perceives the servant perform his duties from principle, and the servant should endeavour to please his master cheerfully, even in what he may consider his whims. If these rules were mutually observed, there would be fewer flittings at terms than is the case at present. Both parties should consider that their new move may place them in a *worse* position than before; at the same time, it

must be owned, that a servant of slow habits, however honest he may be, is a great bar to the work of a farm, where it is carried on in a smart way; and it is a constant source of irritation to retain a servant whose daily conduct excites suspicions of his integrity.

(2346.) *Unmarried* farm-servants, who live in bothies, are usually engaged or re-engaged on the term-day; but those who live in the masters' house are usually spoken to, to remain in their service, 40 days before the term. Domestic female servants, and those engaged by married ploughmen to do farm-work, commonly called *bondagers* or *field-workers*, are placed on the same footing. All single servants are engaged for a half-year only.

(2347.) Farm-servants are usually engaged in the hiring-market of the neighbouring town or village, and they seldom exhibit written characters from the masters whom they are serving, referring only to them by name; and should they be found in the market, inquiry is made, but if not, an engagement is made from appearance and conversation. This is doubtless an unsatisfactory mode of hiring, and, to obviate it, it has been proposed to open registers, in which the names of farm-servants of established character and of places may be entered, on payment of a small fee by those who may desire to inspect them. The plan of such a registry was established at Forres in Morayshire, in 1838, by Mr Robert Mitchell, and it is said to have worked well hitherto. At the end of the first year, on 31st July 1839, the number of names entered on the list was 267; at the end of the second year, in 1840, it increased to 636; and at the end of the third year, in 1841, it had risen to 1110. Both masters and servants seem to approve of the plan; and I have no doubt that similar good effects would follow the establishment of a similar registry in every hiring market. "Such a registry would have, in the first place, the effect of procuring agreeable situations for servants of excellent character; and it would, probably, in time, have the moral effect of shewing the careless servant that the industrious, obedient, and skilful, will always be preferred, and this lesson, it is hoped, may have the effect of making the indolent and vicious amend the error of their ways." *

(2348.) On hiring every sort of farm-servants, I would recommend a clear understanding be had with them; and the simplest plan of avoiding misconceptions of the duties to be performed by servants is, *to hire them to do whatever they are desired.* It is necessary to make this stipulation, for some servants are so fastidious as to the nature of their duties, that they will refuse to perform any other than what they were

* Quarterly Journal of Agriculture, vol. xii. p. 298.

specially hired to do. For example, if a man has been hired to drive a pair of horses, he will cheerfully do whatever is done with the labour of horses, but may demur to do any other work when his horses are not employed; and yet very urgent work may have to be done at a time when horses cannot be employed, such as letting off water from land, and many others. In like manner, a dairy-maid may refuse to feed pigs or poultry; and domestic servants may refuse to work out of the house; and it is no uncommon case to hear shepherds and gardeners refuse to do anything, however needful, and however conducive to their master's interest, but what is immediately connected with their respective specific duties. It may be expedient for the shepherd to bind or fork corn at harvest, and for the gardener to cut grass for the work-horses; but these necessary operations will not be performed by either, unless both have been engaged to do what they are desired. Of course, it is always best for labour, to have it performed by those best acquainted with it, and this being the case, it will be the interest of the master himself to use a wise discretion in putting the stipulation into practice.

(2349.) It may be useful to give here a succinct view of the law of contract of hire between master and servant, as it will tend to shew the relative obligations which subsist betwixt them. 1. *Hiring.* It is not necessary to give arles to servants when hiring them; and even after receiving them, servants may resile from the bargain, if it is the custom of the district (Ersk. III. 3, 14.). Farm-servants are presumed to be hired by the year, if no period be agreed on (Finlayson, 1829.). In this same case (June 6. 1829, 7 S. D. 717.), a grieve or farm-steward is held to be engaged for a year. If a servant is engaged for a shorter period than half-a-year, or longer than a year, a written agreement should be made out and agreed to by both parties, otherwise, on the servant denying the period, he may, in the first case, be found entitled to full half-a-year's wages. Either party may refer the engagement to the oath of the other (Tait, Just. Peace, 459.). Should the servant be brought from a distance, it has been found that the hirer is liable in the expense of bringing him, but not in the expense of his return, unless otherwise agreed on (Baird, 1799, 5 B. S. 514.). By 4th Geo. IV., c. 34, persons contracting to serve, and deserting their service after entering on it, are liable to imprisonment.—2. *Master's Obligations.* The master is bound to receive the domestic servant to his situation, and give bed and board, should no agreement be made to the contrary, for the term of service (Bell's Prin. sec. 184.); and he cannot compel a domestic servant to live out of his house (Graham, Feb. 12. 1822, F. C.).—3. *Responsibility of Masters for Servants.* The master is responsible for injury done to third parties through the fault, negligence, or carelessness of his servants, while doing their master's business, but not for their criminal acts (M'Laren, 1827.). The master is not liable for the expense of a medical adviser, called in by the servant, different from the family one; nor will he be liable should the illness of the servant be brought on by his own imprudence; but when the illness is brought on from causes arising in the course of the servant's duties, the master is liable

in expenses (Cooper, 1831, Car. and Pay. Reps.); and the master, in this case, has no right to deduct the expenses from the servant's wages (Lellan, 1829, Car. and Pay. Reps.).—4. *Servants' Obligations.* Servants are bound to serve their master in every thing relating to the situation they have engaged themselves for. They must be respectful to their master and his family, and in their general conduct avoid actions scandalous or of bad example. They have no right to absent themselves without leave (Crawford, 1822.). They are responsible for every thing committed to their charge in the routine of their duty, but not for accidents (Campbell, 1734.). They must accompany their employer in change of residence, as long as he does not leave the kingdom (Tait, 462.). They have no right to draw nice distinctions between what comes under their duty and what does not; they cannot be employed on any duty different from the customary duties of the service they have undertaken, and this renders a specific agreement, to do what they are desired, necessary. Enlistment in Her Majesty's service frees a servant from his obligations by the Mutiny Act.—5. *Wages.* Should no wages be bargained for, none are due (Salton, Brown, Sup. 3, 337.). The servant has a right to leave his master, and claim wages and board-wages, should his wages not be paid at the terms agreed upon. Though a servant is engaged by the year, his wages are payable half-yearly (Tait, 465.). A servant, through sickness, disabled from doing his duty, has still a right to his wages, should no servant be got to supply his place (White, 1794.). Should the servant die between terms, wages to the time of his death will be due to his representatives. When the master dies, wages and board-wages to the next term are due, should there be no agreement for any space of time. When the servant is engaged for any specified time, wages and board-wages are due to the full time. The master's bankruptcy gives the servants the same claim. But in both these last cases, on the servant's being supplied with another place, wages only for past services are due (Tait, 465.). The master can, at any time, turn off his servant, on giving him full wages and board-wages (Cooper, 1825.). A female servant marrying and leaving her master, loses all claim for wages, and her husband is liable in damages.—6. *Grounds for dismissing a servant.* A servant may be dismissed for immoral conduct, disobedience, or habitual neglect of duty (Callo, 1831); for absence on Sunday, when ordered to the contrary (Hamilton, 1824.). Absence for 4 days without leave was held a sufficient cause of dismissal; and legal dismission forfeits the servant's wages (Silvie, 1830.). When either a master wishes to part with a servant, or the servant wishes to leave his situation, warning must be given 40 days before the term, otherwise the engagement is held to be renewed (M'Lean, 1813.); unless the local custom is to give no warning, then none is necessary (Morrison, 1823.). After a servant has received his wages and left his situation, he cannot say he got no warning (Baird, 1779.). It will be observed that much of what has been said applies almost exclusively to *domestic* servants, whether on a farm or not; the relations of out-door farm-servants with their master are so clear, that few questions arise between them, either at parting or during the course of service.—7. *Character of Servants.* The master is not bound to give a servant a character, either oral or written, or to assign a reason for withholding it (Carrol, 1800, 3 Esp. 201.). He will be liable in damages, when asked the character of a servant, in giving an untrue one (Bell's Prin.). He will be justified in giving one prejudicial to the servant, if true (Christian, July 6. 1818. 1 Mur. 427.); but he has no right to give out such a character publicly, without sufficient

cause.—8. *Hiring Workmen.* Workmen, like domestic servants, may be hired by the year, or for a shorter time, but writing is necessary for a longer period (Paterson, June 17. 1830, 6 S. D. 931.). They are bound, besides the principal engagement, to keep to certain regular hours, and observe the same respect and decency as domestic servants. They may be compelled by imprisonment to fulfil their contract (Clerk, Jan. 19. 1799, F. C.).*

53. OF SOWING OAT-SEED.

" Though ley land you break up when Christmas is gone,
For sowing of barley or oats thereupon;
Yet haste not to fallow till March be begun,
Lest afterwards wishing it had been undone.'

TUSSER.

(2350.) After what has been said of ploughing lea-ground (1138.), and of the mode of sowing seed upon the land by hand, fig. 378, and of the properties of different kinds of oats cultivated in this country (1935.), little requires to be added here on the sowing of oats, except the manner in which that operation is *finished.*

(2351.) Beans and spring-wheat are not sown upon every species of farm; the former being most profitable in deep strong soils, and the latter is only to be commended after turnips, on land in good heart, situate in a favourable locality for climate, and the crop eaten off by sheep; but oats are sown on all sorts of farms, from the strongest clay to the lightest sand, and from the highest point to which arable culture has reached on moorland soil, to the bottom of the lowest valley on the richest deposite. The extensive breadth of its culture does not, however, imply that the oat is naturally suited to all soils and situations, for its fibrous and spreading roots indicate a predilection for friable soils; but its general use as food among the agricultural population, has caused its universal culture in Scotland, while its ability to support the strength of horses, has induced its culture to be extended throughout the kingdom; and it is certainly a remarkable fact, with what admirable effect this plant has adapted itself to the various circumstances in which it is cultivated, and this result is, most probably, owing to the same food, namely, the decomposed grasses with which this plant is uniformly supplied.

(2352.) All the varieties of oats cultivated may be practically classed under 3 heads, the *common*, the *improved*, and the *Tartarian*. The com-

* The Farmer's Lawyer, pp. 160-5.

mon varieties include all those having a pyramidal spike, soft straw, long grains possessing a tendency to become awny, and which are late in reaching maturity. Among the *named* varieties are the following in common use: early and late *Angus, Kildrummie, Blainslie*, white *Siberian*, fig. 363, *Cumberland, sandy*, and *Dyock*, which two last are recent varieties, and others. It is unnecessary to point out the superior characteristics of each variety, for in the respective districts in which they are sown, each is considered best suited to the locality in which it is cultivated,—an opinion which may safely be disputed. The four last named are in high repute at present, owing to their recent introduction; and it is probable that any recent variety will answer best for a shorter or longer period. All common oats are sown on the inferior soils, and in the most elevated fields of farms, and the season for sowing them is the beginning of March. Of the improved varieties, are, the *potato oat*, which has long been cultivated as the only variety; but of late years, the *Hopetoun oat* has been added to the short list. Before it, the Georgian was introduced, but did not succeed. Both the potato and Hopetoun oats have long strong straw, large spikes, come early to maturity, and are chiefly cultivated on the best and lowest lying ground. The grains are very similar, the Hopetoun being distinguished by a tinge of red on the bosom, fig. 362. These oats are sown a fortnight after the common. The cultivation of the *Tartarian* varieties, both *black* and *white*, is chiefly confined to England, for the use of horses, and are there called *feed* oats. I am surprised that this oat should be cultivated at this time of day, both on account of its coarseness, as well as the disagreeable work which it occasions in the barn by its long hygrometric awns.

(2353.) The ploughed lea-ground should be dry on the surface before it is sown, as otherwise it will not harrow kindly; but the proper dryness is to be distinguished from that arising from dry hard frost. It will not be proper to wait until every spot of the field is dry alike, as even thorough-draining will not insure that; though spottiness shown in spring is a good criterion whether land has been enough drained, or where it most requires it. Should the lea have been ploughed some time before, and from young grass, the furrow-slices will be found to lie close together at seed-time; but should it have been recently ploughed, or from old lea, or on stiff ground in a rather wet state, the furrow-slices will not lie close together, but be as far asunder as to allow a good deal of the seed to drop down between them, and where this happens, the seed will be lost, as oats will not vegetate from a depth of 6 or 7 inches. In all cases of lea where the furrow-slices are not close, in order to save a part of the seed, and avoid a thin crop, the ground should be harrowed a single tine before being sown. The tines of harrows should be parti-

cularly sharp when used for covering in seed upon lea. When oats are sown by hand upon dry lea-ground, the grains rebound from it and dance about before depositing themselves in the hollows between the crests of the furrow-slices, and thus accommodating themselves to the form of the ground, are not so liable to be *happerga'ed* in sowing as other grains. Were the ground only harrowed in along the ridges, so as not to disturb the seed along the furrow-slices, the germs of the crop would come up in as regular rows as if sown by drill; but as the land receives cross-harrowing as well as along, the braird comes up broadcast, notwithstanding the position the seed assumes when it settles on the ground. The quantity of common oats sown is usually 6 bushels to the imperial acre; and in deep friable land in good heart, 5 bushels of potato-oats suffice. A man does a good day's work, if he sows broadcast 16 imperial acres of ground in 10 hours, that is, scatters 80 bushels of potato-oats and 96 bushels of common oats in that time. Some men can sow 120 bushels of common and 100 of potato in that time, that is, 20 acres; and double-handed sowers can sow more than this latter quantity. Two sowers keep one seed-carrier fully employed, and indeed if the sacks are not conveniently placed (2193.), one will not be able to supply them both, but 2 seed-carriers will easily supply 3 sowers; and every sower employs 2 pairs of harrows breaking in after him, with a double tine. So that the number of sowers is regulated by the number of pairs of harrows that a farm can furnish. The arrangement of the labour for sowing an oat-field may be seen in fig. 378, where 2 sowers and 1 seed-carrier are represented, but the harrows of 1 sower only are shewn in view. See from (2199.) to (2203.) inclusive. After the land is broken in with a double tine, it is harrowed across with a double tine, which cut across the furrow-crests, and then along another double tine, and this quantity generally suffices. At the last harrowing the tines should be kept clean, and no stones should be allowed to be trailed along by the tines, to the manifest ribbing of the surface. On old lea, or on hard land, another single turn across or angle-ways may be required to render the land fine enough; and, on the other hand, on a free soil a single tine along after the double one cross may suffice. In short, the harrowing should be continued as long and no longer than the ground feels uniformly smooth and firm under the foot, having no hard places, or others sinking into hollows by the pressure of the foot (2209.). The head-ridges are harrowed round by themselves at last. See from (2206.) to (2210.) inclusive. The land, after the oat-seed is sown, is always *water-furrowed* in every open-furrow (2221.); and it should also be rolled (2220.), according to circumstances; that is, the young braird on strong land being retarded in its growth, when the earth is encrusted by rain after rolling, it is safe to leave the roll-

ing of such land until the end of spring, when the crop has made a little progress, and when the weather is usually dry. Light friable land should be rolled immediately after the seed is sown and harrowed, if there is time to do it; but the rolling of one field should cause no delay to the sowing of others in dry weather. There will be plenty of time to roll the ground after the oat-seed and other urgent operations at this season are finished, and especially as rolling may be so speedily performed as described in (2220.). The cutting of *gaws* should never be neglected in finishing off an oat-field, to carry off water along hollows or in the open-furrow beside the lowest head-ridge, as particularly described in (1137.). Oats are sown broadcast by machinery as well as by hand. The machine is the same as is used for sowing grass-seeds, and figured at fig. 372, Plate XXVI, and already described by Mr Slight in (2242.) to (2255.). As constructed at first upon two wheels, this machine, when loaded with a full complement of oat-seed, was too heavy for a horse's back, especially on going down hill; but the addition of the third wheel disposes of that objection, and I believe it is now pretty extensively employed in sowing corn.

(2354.) But oats are also sown in rows by such drill-machines as are represented in figs. 381 and 382, Plate XXVII, and described below by Mr Slight. In using drill-machines, the land should first be harrowed, a double tine along, and then a double tine across the ridges, and again a single tine *along*. The drill then sows the oats *across* the ridges, and the land is finished by harrowing a single tine also *across* the ridges. The water-furrowing and rolling should be executed in the manner described (2353.) for broadcast sowing. The drill seems to me not well adapted for sowing corn on *lea*-ground. It cannot pass through it, even after it has been well cut with the harrows, with the facility it does through ground in a soft state; and on hard ground and upon old lea, it is questionable whether the coulters can penetrate so far as to deposite the seed at a depth to be out of reach of birds and drought; and every stone in such ground being rather firmly embedded, will be apt to cause the drill to go out of its proper course, while at the same time the risk of at least of partially displacing the old uncorrupted turf will be imminent. In these latter cases I would recommend the broadcast machine or the hand in preference to the drill; and I would confine the drill in sowing oats to tender land as in the neighbourhood of towns, where it is made tender by the application of large quantities of street-manure, and where drilling is advisable as affording a facility for cleaning the land of surface-weeds, a multitude of which, and especially wild mustard, *Sinapis arvensis*, are apt to spring up from the use of street-manure. In England, however, where the drilling of grain is followed

out, it must be owned that their ploughing with the wheel-plough and sowing with the drill-machine, are so perfect in their operation, that the seed is laid in the furrows with certainty, and without at all disturbing the furrow-slice.

(2355.) At a time when a less rational system of husbandry was pursued than now happily prevails, that is, when land was allowed to be overrun with surface-water; when lea was ploughed out of choice in a wet state, because the labour of doing it was easier for half-starved jaded horses; when land was harrowed with small, light, loose harrows, furnished with short blunt tines; when the lea-turf consisted chiefly of the tough roots of perennial weeds—in these circumstances lea-ground required a great deal of harrowing to bring it to a tolerable degree of tilth, eight or nine double tines being considered no more than necessary. The great length of time required to do this, obliged the oat-seed to be begun early, so early indeed as Tusser recommends it to be begun in January,—

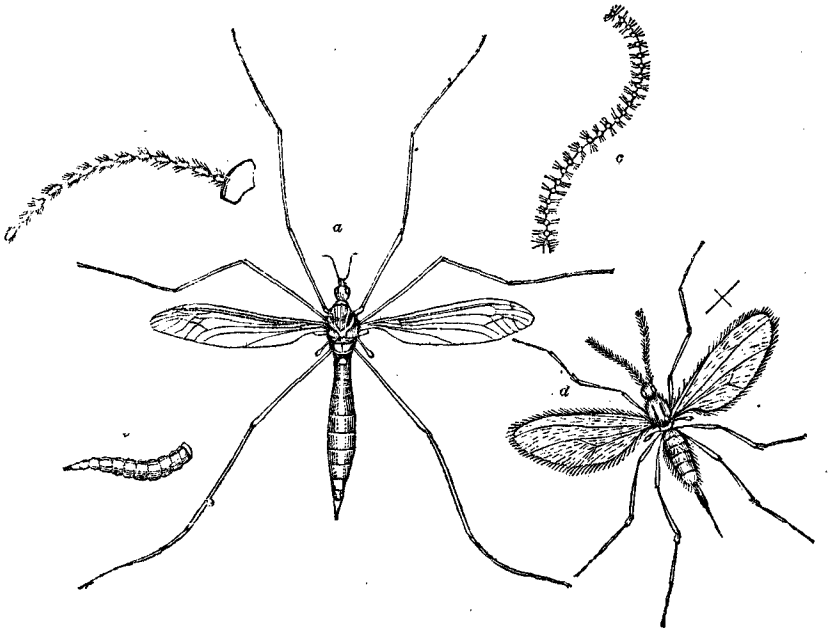
> "In January, husband that poucheth the groats,
> Will break up his ley, or be sowing of oats;"

if the husbandman desires to pocket the gain of a good crop; and by the time the crop was finished, every creature, man and beast, were almost worn out with fatigue. The land being now made tender and fertile by draining, cleaning, and manuring, oats have time to come to maturity when sown long after January, and its harrowing is now finished in one-third of the time, and with one-fourth the labour it was then.

(2356.) The oat-crop, when very young, that is, when the plant has not pushed its leaves more than 2 inches above the ground, is subject to a very serious disease called the *grub*, a name derived from the grub or larva of a particular insect, the *Tipula oleracea, Meadow-crane-fly*, attacking its roots, and causing the plant to decay, and even to die when seriously injured by this insect. The perfect female insect is represented of the natural size at *a*, fig. 394, and which will at once be recognised as that well known by the familiar names of *Long-legs, Tailors, Jenny-the-spinner*. Its body is nearly 1 inch long, of a brownish-grey colour, and its wings pale-brown. In the female the abdomen is thickest near the middle, from which it tapers to a point at the hinder extremity; that of the male is thickest at the hinder extremity, which forms a kind of club. "This insect," says Mr Duncan, "is very plentiful during the summer months in all parts of the country. Its long legs are of great advantage to it in places it frequents, as they enable it to skip over the grass as if on stilts; and it still farther facilitates its motions while so doing, by keeping the wings expanded, to render it buoyant. The female lays a great number of eggs, which are very small in proportion to the size of the insect, and of a black colour. These she places at some depth in the earth, which she pierces for the purpose with her ovipositor. The insects may easily be seen performing this operation, and it will at once be known that they are so employed by the singular position they assume. The body is placed in a perpendicular direction, supported on the hinder feet and extremity of the abdomen, while the wings are expanded, and the anterior legs rest on the surrounding plants. When a sufficient number of eggs have been laid in one spot, the insect moves on to another, without changing the vertical posture of her body, merely dragging herself forward by her fore-legs, aiding her movements with her wings." It is in the larva state that these insects injure crops, meadow-grass not being their only food, they attack

different kinds of corn, especially oats, the effects of *grubbing* in which are well known to every farmer. When full grown, the larvæ are in the shape of an

Fig. 394.



THE LARGE INSECT WHICH PRODUCES THE GRUB IN OAT-FIELDS.

elongated cylinder, somewhat suddenly attenuated at both extremities, and are of a dull-greyish colour, and without feet. The head is furnished with two hooks, one on each side. The pupa is not unlike the chrysalis of some kinds of moth; and it is nearly of the same colour as the larvæ, the edges of the segments being furnished with pretty strong hairs. The larvæ reside generally about 1 or 2 inches beneath the surface, mining their way among the roots of the herbage, and causing it to wither for want of nourishment. They prefer a soil which has been long undisturbed by the plough; and if it contains some portion of peat-earth, it seems thereby better adapted to their tastes. "In the rich district of Sunk Island, in Holderness, in the spring of 1813," says Messrs Kirby and Spence, "hundreds of acres of pastures have been entirely destroyed by them, being rendered as completely brown, as if they had suffered a three months' drought, and destitute of all vegetation, except a few thistles. A square foot of the dead turf being dug up, 210 grubs were counted in it; and what furnishes a striking proof of the prolific powers of these insects, last year it was difficult to find a single *one*."* "After mentioning their extensive devastations, it may occasion surprise," as Mr Duncan well remarks, "to be told that many eminent observers are of opinion, that these maggots eat nothing but the fine mould they find at the roots of plants, and that the injury caused to the latter

* Kirby and Spence's Introduction to Entomology, vol. i. p. 318.

arises solely from their disturbing the soil, and preventing the rootlets fixing themselves. Such was the opinion of Reaumur; and the generality of subsequent writers on the subject have yielded to his authority. . . Mr Stickney, who has published '*Observations on the Grub*,' made some experiments for the express purpose of determining this point, and they convinced him that the larvæ devour the roots of grasses. Indeed, unless this were the case, it would be impossible to account for the herbage withering to such an extent in places where the maggots prevail; for this could never arise from such small creatures, even though very numerous, burrowing in and loosening the soil. When earth-worms are plentiful, they must produce a considerable disturbance in the soil by their winding galleries; but these, so far from retarding, have always been regarded as promoting the growth of plants. 'The grub of this tipula,' says Mr Stickney, as quoted by Mr Duncan, 'commits its ravages chiefly in the first crop, after the breaking up of the grass-land, also after clover and beans; the fly from which the insect is produced having deposited its eggs in the soil amongst the grass, clover, or beans. . . On investigating the habits of this insect, I found that it took the fly-state about the beginning of the month of August; I therefore concluded, as we got our clover-hay from the land a little after midsummer, that, if we ploughed the clover stubble any time after that, and before the month of August, it would be nearly free from the grub, as instinct has directed the fly not to leave its eggs upon the naked soil where no vegetable is growing. I knew of no application to the land,' adds Mr Stickney, 'that will in any way destroy the grub; but we are much indebted to the rook, and a variety of other birds, for keeping its depredations within limited grounds.'* The saturation of the soil," concludes Mr Duncan, "with some caustic fluid, seems the only way by which this maggot can be destroyed. The perfect insects are easily caught; but they are so generally distributed, and usually so plentiful, that their destruction in this way would be a hopeless task."† The rook (*Corvus frugilegus*) may be seen busily engaged in turning over every loose turf clod on a grubbed field of oats, after the young crop has evidently assumed an unhealthy hue. This hue should not be mistaken for the yellowish tint exhibited by the plant when the support derived from the seed is exhausted, and before the rootlets have obtained sufficient scope in the ground to maintain the plant. The grub taint is of a bluish and reddish tint, and many of the plants evidently appear to be dying, and the consequence is, that large spaces are left without a plant. The usual expedient employed by the farmer is rolling the ground, especially in the night; but this is a useless remedy. Holes have been recommended to be made a few inches asunder with the dibble, into which the grubs, it is said, will fall and perish; but why they should thus die when they can penetrate the ground, is what I cannot conceive. The ravages are generally committed in dry weather with an easterly wind, and when rain falls they cease. It is surprising how a field will recover from the effects of grubbing. One season a field of mine, of fine deep hazel loam, after two years grass, was dreadfully grubbed, and after trying the usual remedies to get quit of the insects without effect, a rainy night silenced them. Most of the field appeared bare after having exhibited a beautiful braird, but on the plants acquiring renewed growth, they tillered out with great force, and almost covered the ground as thickly as desir-

* British Farmer's Magazine, vol. vi. p. 321.

† Quarterly Journal of Agriculture, vol. xi. p. 368–72.

able. At harvest the crop was a very strong one, the straw being difficult for women to cut with the common sickle; the spikes were very large and full; the stooks, when set without hood-sheaves, stood about 6 feet in height, and the yield was not less than 60 bushels to the imperial acre. On good soil I would have no fear of potato oats tillering out after being severely grubbed, sufficiently to afford a good crop; but such a result should not be expected of common oats upon inferior soil.

(2357.) [*Grain Drilling-Machines.*—The introduction of the drill-system into the agricultural practice of any country, will always form an era in the annals of its agriculture; but it is often a difficult matter to define the precise time of its introduction, more especially when we find that, by tracing backward into the history of man in his social capacities, the practice of drilling grain extends backward to the most remote antiquity. A curious and interesting example of this, in an antiquarian point of view, is to be seen in the series of Hindoo models of agricultural implements in the Museum of the Highland and Agricultural Society in Edinburgh. Amongst them is to be seen a correct model of a rudely constructed drill-machine possessing all the essential points of the more elaborate modern implement; and amongst a people so little liable to change, there can be no doubt that the machine is of very remote origin, compared with which, the earliest of our modern drills are but things of the moment; and all of them, of whatever degree of merit, are but improvements on the Hindoo original. Amongst the early notices of the introduction of the system in England, we find Amos* recommending it as early as 1783 as the result of numerous comparative experiments; and the figures which he gives of the drill sowing-machine, which he recommends not as an original invention, but an amplification of that given by Duhamel, is almost identical in every essential point with the most approved drill sowing-machine used in the present day in England, and which may be held as the most perfect machine of its kind; but from the excessive elaboration employed in its construction, its high price lays an interdict upon its introduction into the economical practice of Scotch farming, the price being at least six times that of the common drill used in Scotland.

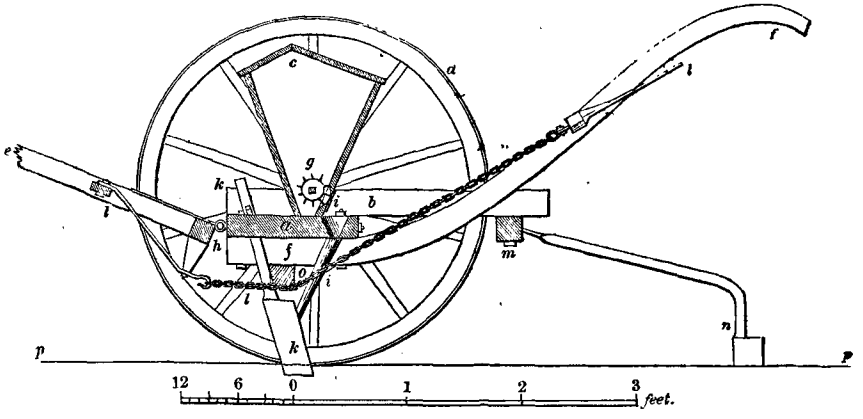
(2358.) The mode of distributing the seed adopted in the broadcast sowing-machine, from the simplicity of the principle, opened a ready means of acquiring a drill sowing-machine at a moderate price; it accordingly quickly followed the introduction of the broadcast-machine, and until very lately no change of importance has been made upon the common Scotch drill. Slight modifications, however, had been effected occasionally, such as varying the distance between the rows, the machine always covering the same breadth, but varying in the number of coulters. Thus, a machine to cover 7½ feet in breadth, could change the number of its coulters from 11 to 10, 9, or 8, the spaces between the rows being respectively 8, 9, 10, and 11 inches, or thereby.

(2359.) The *Common* or *East Lothian Drill Sowing-Machine*, has been here taken to illustrate the principles of the machine. Though it may be deficient in some points as compared with those of Berwickshire and Roxburghshire, yet its extreme simplicity and cheapness has brought it into very extensive adoption, not only in East Lothian, but in other districts where the drill-system is followed. Fig. 381, Plate XXVII, is a view in perspective of this machine, and for the better elucidation of its construction, the annexed

* Theory and Practice of Drill-Husbandry. By William Amos, 1802.

cut, fig. 395, shews the arrangement of the parts in longitudinal section, and for convenience of reference the letters mark corresponding parts in both figures.

Fig. 395.



SECTION OF THE COMMON DRILL-SOWING MACHINE.

The figures represent a machine of six rows, which is the size most generally used, chiefly because it can be drawn by one horse; but also in the event of its being employed along swelling ridges, its covering but a small breadth secures a nearly equal depth for the deposition of the seed, which cannot be easily done under the same circumstances if the machine is mounted with a greater number of coulters. But it follows from the peculiarity of structure, the coulters being permanently fixed in position for the depth to which they penetrate the soil, that the machine is best adapted for sowing across the ridges, and hence it is almost invariably worked in that direction, though when worked in the direction of the ridge the breadth covered by the machine is equal to one-fourth of an 18-feet ridge.

(2360.) In the construction, *a* is a bed-plank 5 feet 1 inch in length, 14 inches in breadth, and $2\frac{1}{2}$ inches in thickness. Across the ends of this are bolted the two side-bars *b b*, each 33 inches in length, $2\frac{3}{4}$ inches in depth, and $2\frac{1}{4}$ inches in breadth. These last are crossed by the bar *m m*, bolted to the side-bars, serving a special purpose, to be afterwards noticed; and these four parts form the simple frame-work of the machine. The seed-chest *c* is 4 feet 8 inches in length, placed between the side-bars *b*, and attached to these and the bed-plank. The chest may be about 10 inches in depth, $2\frac{1}{2}$ inches wide at bottom, and 15 inches at top, with a hinged cover. The chest, so mounted with the seed-wheels and axle *g*, fig. 395, and with side-plate, lever, and adjusting screw, in all respects similar to the broadcast machine (2245.), except that, in place of the *apron* on which the seed falls in the broadcast, the orifices deliver the seed directly into a small hopper-shaped aperture formed in the bed-plank, immediately under the orifice *i*, fig. 395. The carriage-wheels *d d* are 3 feet 1 inch in diameter; the axle of one of them is seated in a strong bush or plummer-block, and coupled to the small shaft of the seed-wheels, thereby giving them the requisite motion, their revolution coinciding with that of the

wheels, and the opposite wheel *d* turns upon an axle fixed permanently upon the bed-frame. The horse-shafts *e* are jointed to the bed-plank at *h*, and appear broken off at *e*, fig. 395, by strap-and-hook hinges, and the handles *f f* are bolted to the lower side of the bed-plank. The coulters *k k* consist of an iron shank $\frac{3}{4}$ inch square, furnished at the lower end with a pointed sheath of sheet-iron about $\frac{1}{10}$ inch thick; the sides of this sheath, being about 3 inches broad, and 5 inches or more in height riveted upon the bottom of the shank, which at this place is forged into a wedge shape, to receive the sheath. The coulters are fixed at top in mortises cut in the bed-plank, and fenced with plates of iron above and below, where they are secured by means of wedges; and they are further supported by the coulter-bar *o*, seen in section in fig. 395. This bar is bolted under the heel of the handles, and to it the coulters are attached by eye-bolts. The seed on leaving the orifices, falls into the funnel-shaped receptacle *i* in the upper side of the bed-plank, from which it passes down the tube *i i* into the sheath of the coulter, by which it is deposited into the rut formed by the sheath.

(2361.) From the construction and action of this machine, and the resistance of the soil to the passage of the coulters through it, there is a constant tendency, produced by the traction of the horse when the machine is in action, to elevate the extremity of the handles; and by thus swinging upon the axle of the wheels, the coulters are withdrawn from their action on the soil, and from forming the rut for the reception of the seed. The tendency thus produced being greater than a man is capable of continuing to contend with, is counteracted by the application of the balance-chain *l l*, as shewn in fig. 395, producing a change of direction in the line of draught, and of the point of attachment of the draught. In this machine, the true point of attachment is in the hinge *h*, fig. 395; and the tendency of the draught, when applied simply to this point, is to cause the point *h*, to approach an imaginary straight line lying between the horse's shoulder and the point of resistance at lower *k* in the figure, and the effect of this is to bring *h* forward and downward, or to throw lower *k* backward till it loose hold of the soil, thereby destroying the intended effect of the coulter. The counteraction of this is effected by the position of the balance-chain, and its attachments to the machine. The first part of it is a simple rod, fixed to the shafts at *l*, and to the extremity of a pendant attached to the hind bar of the shafts at *h*; the chain then passes under the coulter-bar o, and on to the cross-bar of the handles, as seen in fig. 381, Plate XXVII, where it terminates in a handle furnished with a spring-catch, by which it can be hooked under tension, to the cross-bar of the handles, or by disengaging the catch, the chain hangs loose. When the chain is brought under tension, and the shafts borne up by the horse, the resistance to the coulters is transferred to the back of the horse, through the medium of the chain acting on the shaft at the point *l*, and on the pendant *h*, the point of which being below the plane of the shaft, changes the direction of the tractive force from *e h* to *e* middle *l*, and leaves the handles in a nearly quiescent state. The marker *m n* is another appendage to the machine, which, although not so necessary as the balance-chain, is yet generally applied to this drill-machine, especially when sowing across the ridges. It consists of the bar *m m*, and the marking-rod *m n*. The latter is swing-jointed on a stud fixed in the ends of the marker-bar *m m*, and having a stop on the joint, by which either of the markers can be retained in the position of that on the further side of fig. 381, or let down, as in that of the nigh side. The use of the marker is to trace a line on the surface of the ground parallel to the direction in which the machine travels,

and at a distance from the middle point of the surface covered by the machine, equal to the entire breadth, so covered; hence, on returning to sow the next breadth, the horse should walk exactly upon the line drawn by the marker. In sowing with the machine here described, the distance from line to line will be 4 feet 6 inches; the distance between the rows being 9 inches. The wheels are usually set 54 inches apart, measuring at the point where they rest on the ground; or their distance in any machine may be found by multiplying the number of coulters by the number of inches given to the interval between the rows or coulters; thus six coulters at 9 inches of interval, give $6 \times 9 = 54$ inches. From the construction of the machine it is found, that when the balance-chain is under tension, the coulters are drawn to the ground, and the handles also drawn downward; but on releasing the chain, which is done at the land-ends and turnings, the conductor must support the handles to keep the coulter from the ground, and in this state, if the handles are let go when the machine is standing, the coulter will pass forward, and the handles will fall to the ground. To prevent this last inconvenience, a crutch is usually appended to the marker-bar, which, on stopping, is allowed to drop to a perpendicular position, resting on the ground, and thus keeps the machine upon a level. This appendage not being of much importance, is left out of the figure.

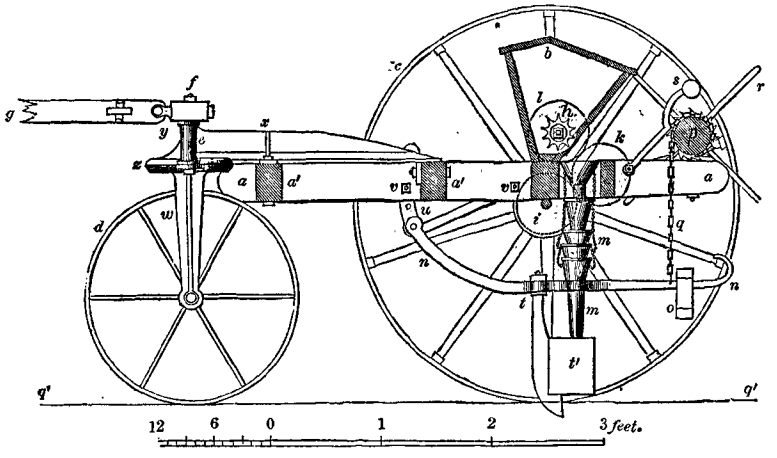
(2362.) This sowing machine has been long and successfully manufactured by Scouler and Company of Haddington; and with slight variations by various other implement-makers, as Morton, Leith Walk, Edinburgh; James Slight and Company, Edinburgh, &c. The price varies according to the number of coulters, from L.6 to L.10.

(2363.) *New Lever-Drill Sowing-Machine.*—Fig. 382, Plate XXVII., represents a drill sowing-machine, introduced about three years ago by James Slight and Company. Mr Slight having been impressed with the superiority of the improved English lever-drills, but seeing at the same time the difficulty, or impossibility of introducing such an expensive machine into the Scotch practice, was induced to make the attempt of engrafting what appeared the better parts of the English machine upon the more simple machinery of the Scotch, thus producing a machine little, if any thing, inferior to the original, at one-third of the price. The results appear to justify the expectations, for the new lever drill has now been tested in the hands of a number of practical judges, and found to give entire satisfaction, either sowing grain alone, or depositing the granulated manures along with the seed in any required proportion. The figures here given of the machine represent it without the manure-chest, which, when adopted, is placed immediately before the seed-chest, making very little change in the appearance, and adding little to the apparatus, except the chest itself.

(2364.) While fig. 382, Plate XXVII. exhibits the machine in perspective, the annexed cut, fig. 396, shews more distinctly the arrangement and construction of the parts, by a longitudinal section. In these figures the corresponding parts are marked as far as possible, by the same letter of reference. In the construction of this drill, the bed-frame *a a*, consists of two side-rails 5 feet 2 inches in length, 4 inches in depth, and $2\frac{1}{4}$ inches in breadth, with three principal cross rails *a'*, fig. 396, mortised into the former, besides a minor rail, forming the bearing or platform of the seed-funnels. The three principals are each 4 inches by $2\frac{1}{4}$ inches, the minor rail being only $1\frac{1}{2}$ inch in breadth. The entire width of the bed-frame for a 6-row drill is 4 feet 7 inches over all, and the length over the rails is 4 feet 3 inches. The seed-chest *b*, which is 4 feet 7 inches long, has its sides

12 inches deep, and is constructed and mounted in every respect similar to that of the broadcast-machine, excepting again the projecting apron, which in the

Fig. 396.



SECTION OF THE NEW LEVER-DRILL SOWING-MACHINE.

drill-machine is not required, and, in the mode of communicating motion to the seed-wheels *h*, fig. 396. The carriage-wheels *c c*, are 3 feet 6 inches diameter, and have their axle bolted to the lower side of the bed-frame; the wheels may be either constructed in the usual manner with wooden-fellies and hooped, or, as in the figure, with a strong hoop of iron only. The fore-wheel *d*, is 2 feet diameter, mounted in the sheers *w*, and *e* is one of the two pillars of the swivel plate, to which the splinter-bar *f* is attached. The shafts *g g* are jointed to the splinter-bar by a draught-bolt passing through eye-bolts in the bar and through the ends of the shafts. The remaining parts, *x*, *y*, *z*, of the fore-carriage are precisely the same as described (2245.) for the broadcast sowing-machine. The sowing geer in the lever-drill consists of a wheel *i* fixed upon the inward end of the cast-iron nave of the carriage wheel, on the nigh side; of a second wheel *k*, placed intermediate between *i* and the third wheel *l*, which last is mounted on a continuation of the seed-wheel shaft *h*, fig. 396; these three wheels are all equal, and are 7 inches diameter. The intermediate wheel *k* is supported upon a stud in the end of a bent lever, the handle of which is seen at the extremity of the side-rail of the bed-frame, and below the roller *p*; by means of this lever the wheel *k* is withdrawn from the wheel *l*, to stop the motion of the seed-wheels. The discharging apparatus of the seed-chest is precisely the same as described in (2249.), with slide *h*, lever *i*, fig. 382, Plate XXVII, and adjusting screw. From the orifice in the slide, the seed falls into funnels *k*, *m m*, each funnel consisting of a series of five joints, each joint sliding freely within the one below; the uppermost being fixed on the platform of the bed-frame, and the lowermost in the socket of the lever *n n*. These funnels are made of the strongest tin-plate, and are strung together by three lines of small chain to prevent their entire dislocation, but allowing sufficient freedom of motion to admit the rise and fall of the lever with its coulter. A quadrant *o*, fig. 382, Plate XXVII, of malleable

iron, is fixed by the bolts *v v*, fig. 396, on each side of the bed-frame, in such a way as to be capable of a change of position in the vertical direction to the extent of a few inches; to this quadrant the levers *n n* are jointed at *u* upon a rod of iron, 1 inch in diameter, which extends from side to side of the bed-frame. The levers are forked at the end *u*, spreading to 9 inches wide, and where the fork unites, the bar is 1 inch by ½ inch; it is perforated at *t* for the reception of the bar *t t'*, and an eye is formed at *m* into which the lower segment of the funnel is fixed; it then diminishes gradually to the extremity *n*, which is turned up to prevent the weight from being dropt off. The weight *o*, fig. 396, is a block of cast-iron of from 3 to 7 lb. weight, of which there may be several sizes, to be applied according to the state of the land, its purpose being to press the coulter into the ground. The coulter, in this machine, has its cutting edge of solid forged iron, upon which the cheeks *t'* are riveted, forming the sheath, and it is secured in the lever by a screw-nut, while the point of the coulter, sinking 1 inch deeper than the sheath, gives the seed a more pulverized bed than can be produced with a coulter that is level below. A wooden roller *p*, 4 inches diameter, furnished with iron gudgeons and with a ratchet, is supported in a light iron standard at each end, upon the side-bar of the bed-frame. A light chain *q* from each lever is attached to the roller, and a cross *r* being fixed upon the gudgeon at the right hand side, the roller can thus be turned round by means of the cross-arms, the chains wound up to any desired extent, and the coulters lifted from the ground. This operation is found convenient at the turnings, or at any time when the machine is not sowing, and the roller, chains, and levers, are held in the desired position by the pall *s* falling into the ratchet wheel. The coulters are represented nearly out of the ground, which is indicated by the line *q' q'*, fig. 396, and when let down to the working level, they penetrate to the depth of 2 or 3 inches. The distance between the wheels, where they rest on the ground, is equal to 54 inches, as in the common drill, one of the wheels, therefore, will always fall into the track of the former round, which may serve as a marker to the conductor of the machine; but, though not shewn in the figure, a marking bar, similar to that of the common drill, is usually fitted to it as a movable appendage.

(2365.) From the construction of this machine, with its fore-wheel and with its lever-coulters independently movable, its motions are more steady and its management more easy, while the freedom of vertical motion in the coulters gives it the advantage of sowing on any kind of surface, on ridges however round, at equal depths for every coulter, and either across or along the ridges with equal facility. The prices of these machines range from L.10 to L.18. —J. S.]

(2366.) To render the expensive English drill-machines more generally useful, it is not an uncommon practice in England for the owner of one to travel the country with it at seed-time, and undertake to sow the fields of any farm, where the farmer may chose to employ him. The charge is usually 2s. 6d. per imperial acre, the farmer supplying the requisite number of horses to work the drill, and undertaking to deliver it at the farm on which it is to be next employed.

54. OF THE LAMBING OF EWES.

" Ah gentle shepherd, thine the lot to tend,
Of all that feel distress the most assail'd,
Feeble, defenceless; lenient be thy care:
But spread around thy tend'rest diligence
In flow'ry spring-time, when the new dropt lamb,
Tott'ring with weakness by his mother's side,
Feels the fresh world about him; and each thorn,
Hillock, or furrow, trips his feeble feet:
O guard his meek sweet innocence from all
Th' num'rous ills that rush around his life."

DYER.

(2367.) The lambing season of Leicester and other heavy breeds of sheep, reared in the arable part of the country, commences about the 11th of March, and continues for about the space of 3 weeks. There is no labour connected with the duties of the shepherd which puts his attention and skill to so severe a test as the lambing season; and a shepherd, whose unwearied attention and consummate skill become conspicuous, at that critical period of his flock's existence, is an invaluable servant to a stock farmer—his services, in fact, are worth far more than the amount of wages he receives; for such a man will save the value of his wages *every year*, in comparison with an unskilful shepherd, and especially in a precarious season, by so treating both the ewe and lamb, during the time, and for some time after the lambing season, that the lives of many are preserved that would otherwise have been lost. To make my meaning more plain, suppose a shepherd that has attentively observed the tupping, and marked the reckoning of every ewe, and who has put the ewes in proper time in a suitable place to lamb in,—that renders them requisite assistance, and no more, at the proper instant of lambing, and treats them afterwards according to the circumstances of the weather,—that sees the lamb supplied with milk by day and night, when its mother happens to be unkind to it, or feeds it with milk obtained elsewhere, when the ewe has too scanty a supply to support it,—that knows how to afford relief to the ewe in case of sickness and inflammation after lambing, and who castrates the lamb at the proper period of its strength, and in the proper state of the weather,—that knows the manner how, and the time when, to put an additional lamb to a ewe that has abundance of milk, and to take it from another which has too little for a pair,—suppose that by doing all this in a skilful manner, night and day, until the lambing is not only entirely completed, but the lambs

reared beyond danger, he saves the lives of 10 ewes worth 40s. each, and of 20 lambs, that will come to be worth 20s. each, and this is no extravagant supposition in a large standing flock of 15 score of ewes, it is clear that, in so doing, he will save his wages of L.40. Few shepherds are so successful, although I have known two instances of such success; and no better proof need be adduced of the fewness of skilful shepherds, than the loss which every breeder of sheep sustains every year, especially in bad weather. I knew a shepherd who possessed unwearied attention, but was deficient in skill, and being over-anxious, always assisted the ewes in lambing before the proper time; and as he kept the ewes in too high condition, the consequence was, that every year he lost a number of both ewes and lambs, and in one season of bad weather the loss amounted to the large number of 26 ewes, and I forget of how many lambs, in a flock of only 10 score of ewes. I knew another shepherd who was far from being solicitous about his charge, though certainly not careless of it, yet his skill was so undoubted, that he chiefly depended upon it, and his success was so eminent, that the loss of a ewe or of a lamb under his charge was matter of surprise. Of these two sorts of shepherds,—the attentive and the skilful,—it would appear that the skilful is the safer, and of course the more valuable, though it must be owned, that it is better to *prevent* evils by skilful attention, than to *cure* them by attentive skill; yet it is only by the union of both these qualities that a perfect shepherd can be formed. In contradistinction to a skilful shepherd, whose qualifications have been just noticed, let me advert to a few particulars mentioned by Mr Price as occurring, apparently as a matter of course, at the lambing season. He says, that in preparing ewes for lambing, "the ewes are driven into a pound, and the looker takes them singly, *throws them down*, and removes with the shears the wool on their tail, udders, and inside of their thighs." If this is a common practice, think of its barbarity, of throwing down a ewe on the ground big with lamb, nay, on the eve of lambing, in order to remove a trifling impediment to the lamb's sucking, which can be removed at any time after lambing. But there is a reason, it seems, for this treatment, called *clatting*, and it is this:—"The removal of the wool renders the part much *neater*," neatness of appearance being preferred at this particular time to the comfort and ease of the animal, "and enables the lamber to see *when the ewe has lambed*, from a stain which generally appears on the back part of her udder. Were *not* this appearance to take place, the *lamber would sometimes be at a loss*, as the young ewes frequently desert their young, and endeavour to escape along with the other ewes, grazing with as much unconcern as if nothing had happened." Observe here the great skill and

attention of a shepherd who is at a loss to know whether a ewe has lambed or not; and who, it seems, does not even know whether a ewe is in lamb or not until he has thrown her down to remove the wool; for, "the barren ewe, or those which are not pregnant, *are distinguished at the time of clatting* by not having any swelling in their udder or belly, and by their skipping about nimbly." Think also of what sort of care is bestowed on a newly lambed flock in a low country, when such losses as these are incurred: "I have known thousands of lambs lost from being drowned in a wet stormy night; I once beheld 30 or more lying together drowned in a ditch. The ewes and lambs seek the corners of pasture-fields during the continuance of severe weather, and when the lambs get under these high shores and fall in, it is utterly impossible for them to extricate themselves; besides, as there are many huddled together, they often push one another in." That lambing paddock must be strangely managed which presents such a scene as this;—"Lambing presents a scene of confusion, disorder, and trouble, which it is the lamber's business to rectify, and for which he ought always to be prepared: some of the ewes perhaps leave their lambs, or the lambs get intermixed, and the ewes which have lost their lambs run about bleating, while others want assistance." It seems a shepherd cannot recognise the lambs of ewes, and so they must be marked. "The twins are marked with a mixture of tar and lamp-black, by means of small figures fixed in an iron handle about 8 inches long;" "and the twin lambs are easily separated, for the ewe very frequently walks away with one lamb, leaving the other in the field, *to the confusion of the lamber; therefore* they should be marked as early as possible to prevent this confusion." "The lamber must take the lamb to its mother, which he will find out by its number;" and yet the number, it seems, will not always enable the lamb to find out the mother; for "if the lamber finds a young lamb, and is *not certain which may be its mother*, a circumstance which sometimes occurs when ewes drop twins, and left one of them, he may readily discover her by taking away the lamb she is fostering, and putting the doubtful one on in its stead, when she will display evident tokens whether its belongs to her." This method of trial and error the shepherd may have, of course, to put to every ewe before he discovers the true mother; for as he knows neither the mother nor the lamb, the lamb may chance to belong to a ewe which has a single lamb as well as to one which has twins, unless the single lambs are left unmarked; or, at any rate, he may present the marked and known-to-be-a-twin lamb to a ewe that has a single one, as readily as to one that has twins. It will excite no surprise to learn that with shepherds *so* wretchedly qualified for their profession, as the above

particulars shew, in "most years not more lambs than one to each ewe" were obtained; and that out of 800 ewes of a certain flock only 100 pairs were saved, though it is stated by Mr Price, that with more skill afterwards the number of pairs increased to 200. Here, then, is an instance where the improved skill of one man saved the lives of 200 lambs, which would come to be worth L.200, equalling the wages of at least 4 good shepherds.* I would not have noticed these egregious blunders, said by Mr Price to be committed by shepherds in a low country like Romney Marsh, in Kent, so prominently, had not Mr Youatt adopted the sentiments of Mr Price in the very particulars quoted above, in his excellent treatise on the history and diseases of sheep.† Were a shepherd of a Leicester flock in Scotland made aware that he was suspected of such ignorance of the nature of sheep, he would be quite ashamed; and so would shepherds even of the hill country, who cannot have so intimate a knowledge of every individual of their flock, usually occupying a wide range of mountain land, as their brethren of the profession tending flocks within much more limited bounds.

(2368.) Before the season of lambing arrives, the shepherd should have a small field of 1 or 2 acres or a sheltered corner of a grass-field of like size, conveniently situated as near the steading as possible, fenced round with nets, and fitted up with sheds made of hurdles set up in the most sheltered part against a wall or hedge, and lined in the inside and comfortably roofed with straw. Such straw-sheds form most comfortable places of refuge for ewes that may lamb in the night, or, that have lambed in the day, and require protection from frost, snow, rain, or cold in the night, until the ewes are perfectly recovered from lambing, and the lambs sufficiently strong to bear the weather in the open field. The small hand turnip-slicer, fig. 245, will be found on such occasions a very convenient instrument for cutting turnips in such turnip-troughs as fig. 225, for the ewes in the paddock, or in small boxes for them in the shed. Common kale or curly greens is excellent food for ewes that have lambed, the nutritive matter of which being mucilaginous, is wholly soluble in water, and beneficial in encouraging the necessary discharges of the ewe at the time of lambing. According to the late George Sinclair, 1 lb., or 7000 grains of green curled kale (*Brassica oleracea viridis*), yields 5680 grains of water, 880 grains of woody fibre, and 440 grains of nutritive matter, which last is all soluble in water.‡ In

* Price on Sheep, p. 115-26.

† Youatt on Sheep, p. 500.

‡ Sinclair's Hortus Gramineus Woburnensis, p. 407, edition of 1824.

these respects kale is better food for ewes *after* lambing than Swedish turnips, which become rather too fibrous and astringent in spring for the secretion of milk. A large lantern which sheds plenty of light is an essential article of furniture at night to a shepherd. As foxes are apt to snatch away young lambs at night even close to the lambing-houses, I have found an effectual preventive to their depredations in setting a sheep-net, as in fig. 217, in front of the lambing-houses, leaving a sufficient space for a few ewes with their lambs taking up their lair within the net. When thus guarded, the foxes are afraid to enter the net, being apprehensive that it is set as a trap to ensnare them. Such an expedient is even more necessary in the corner of the field chosen for the lambing-ground. A large lantern fixed on a stake within the lambing-ground, and so placed as to throw light upon the whole ground, will be found a useful assistance to the shepherd in showing him the ewes that evince symptoms of lambing. A net and lantern are also good safeguards against foxes at night in the grass-field where the recovered ewes with their lambs should be gathered for the night. This expedient of net and lantern I was induced to try after losing, for a year or two, several lambs by the fox; and such was its efficacy in deterring that nightly prowler from visiting the lair of ewes and lambs, that not a lamb was lost ever after. A fox will not meddle with a lamb above a month old.

(2369.) Being thus amply provided with the means of accommodation, the shepherd, whenever he observes the predisposing symptoms of lambing in as many ewes as he knows will lamb first,—and these symptoms are, enlargement and reddening of the parts under the tail, and drooping of the flanks,—he places them, of an afternoon, within the enclosed lambing ground in the paddock or field, as described above, and provides them with cut turnips. The more immediate symptoms of lambing are when the ewe stretches herself frequently; separating herself from her companions; exhibiting restlessness by not remaining in one place for any length of time; lying down and rising up again, as if dissatisfied with the place; pawing the ground with a fore-foot; bleating as if in quest of a lamb; and appearing fond of the lambs of other ewes. In a very few hours, or even shorter time, after the exhibition of these symptoms, the immediate symptom of lambing is the expulsion of the bag of water from the vagina, which, when observed, the ewe should be narrowly watched, for the pains of labour may be expected to come on immediately. When these are felt by her, the ewe presses or forces with earnestness, changing one place or position for another, as if desirous of relief. Up to this time, not a hand should be put upon

her, nor until the hoofs of the fore-feet of the lamb, and its mouth lying upon them, are distinctly seen to present themselves in the passage.

(2370.) The natural presentation of the lamb is the same as that of the calf, described in (2080.). When time has been given to observe that the ewe is not able to expel the lamb by her own exertions, it is the duty of the shepherd to render her assistance, before her strength fails by unavailing pressing. The exact moment for rendering assistance can only be known by experience; but it is necessary for a shepherd to know it, as there is no doubt that hasty parturition often superinduces inflammation, if not of the womb itself, at least of all the external parts. When assistance should be rendered, the ewe is laid gently over upon the ground on her near or left side, and her head a little up the hill; and to prevent her being dragged on the ground when the lamb is being extracted, the shepherd places the heel of his left foot against the belly of the ewe, and kneels on his right knee on the ground across the body of the ewe, which lies between his heel and knee, with his knee pressing against her rump. Having both his hands free, and his face towards the tail of the ewe, he first proceeds to push out *from* him, with both hands, one leg of the lamb and then the other, as far as they will go; then seizing both legs firmly, above the fetlock joints, between the fingers of his left hand, he pushes them from him downwards from the ewe's back, with considerable force, whilst by pushing in the space between the tail of the ewe and the head of the lamb *towards* him, with the side of his right hand, he endeavours to slip the vulva of the ewe over the cantle of the lamb. These pushes are only given simultaneously with the pressing of the ewe, merely to assist her, and keep good what is obtained at each pressing, and not, as it were, to tear the lamb from her per force. Whenever the head is cleared, the shepherd seizes the neck of the lamb behind the head with the right hand, and pulls out the body. The lamb is then placed at the ewe's head, for her to lick and recognise, which she will instantly do, if her labour has not been severe; but if it has, she will likely become sick, and be careless of the lamb as long as the sickness continues, which is evinced by quick breathing. If the pains have been very sharp, and this her first lamb, and she is not overcome by sickness, she may start to her feet, and run away from the lamb. The attempt should, of course, be prevented, and the tail of the lamb put into her mouth, to make her notice it. While still lying on her side, her abdomen should be felt, to ascertain if there is another lamb to come; and if there is, the pains accompanying its passage may have been the cause of her carelessness for the first lamb; and if the second

one is in a natural position, it will most probably by this time be shewing itself in the passage, and if this be the case, the best plan is to take it away in the same manner as the first, and the ewe feeling the attempt, will at once assist on her part by pressing. The existence of a second lamb is worth attending to on another account, inasmuch as some ewes become so engrossed with the first lamb, that the pains attending the second are neglected by them, and they will indicate no signs of it for a time. When a second is found in her, she must be watched, that whenever it comes into the passage, it may be taken away; but unless it actually makes its appearance there, it should not be attempted to be taken away. Should it not make its appearance in a reasonable time, it may be suspected that the lamb is either dead, or not in a natural position, and examination should be made by the fingers into the state of the case. A dead lamb is easily known by the feel, and should be extracted immediately, as it can afford no assistance of itself; but should the lamb be alive, it may be necessary to introduce the hand, to ascertain its position. Before the hand is introduced, it should be smeared over with goose grease. If the head is bent back, it must be placed straight, or if one leg or both be folded back, they must be brought forward, one by one, into the proper position. In short, all the presentations offered by a lamb require the same means to be used to place them in a proper position, as in the case of a calf; but with a Leicester ewe there is the additional difficulty of two, and even more, lambs at a birth, and of mistaking a leg of one lamb for that of another. The method of extracting a lamb as described above, is adopted by a shepherd who has no assistants; but when he has assistance, he adopts another and more easy plan for himself. The assistant holds the ewe in any way the most easy for her and himself, so as to prevent the body being dragged along the ground while the shepherd is extracting the lamb, which he does by placing himself behind the ewe, and performs the extraction by pulling the legs *towards* him, whilst the assistant endeavours to make the vaginal skin pass over the lamb's head, which, when accomplished, the shepherd seizes the neck by his left hand, and holds the legs still in his right, takes away the lamb as quickly as he can, and places it before the ewe. There is a great difference in the disposition of ewes to assist in lambing. Some, when they find they are assisted, give themselves little trouble; whilst others press with vigour from first to last; and others only press at long intervals. A ewe that presses strongly and continuously, will become sooner exhausted than one that takes more leisure, and in the former case there is more danger in neglecting to make examination of the presentation in time, that is,

before the ewe has become exhausted. I remember of seeing a lamb's head without any of the legs protruded by the ewe, and, being allowed to remain in that state too long, the lamb was found strangled to death by the force of pressing. This was a case of neglect, as the head should not have been allowed to come out without one accompanying leg at least. I remember of another case in which there was no appearance of a lamb, though the ewe had pressed for a considerable time. On examination it was found that the mouth of the womb was closed up. Inflammation had no doubt at one time existed, and a discharge of lymph had caused adhesion. The shepherd, nothing daunted, very ingeniously introduced, in his smeared hand, a pen-knife, between the middle and fore-finger, and cut an incision across the pursed mouth of the womb, and thereby liberated two lambs, and the ewe was not at all the worse for the operation.

(2371.) When lambing has taken place in the day, the ewe with her lambs are best at liberty within the enclosed area of the lambing ground, but in rain or snow, she should be taken under shelter to lamb, and kept there for some time until the weather prove better, or she be completely recovered from the effects of parturition. Should she lamb at night, it should be under cover, whatever may be the state of the weather. In the day, it matters not for lambs how *cold* the air is, provided it is dry. The cleaning or placenta generally drops from the ewe in the course of a very short time, in many cases within a few minutes, after lambing. It should be carried away, and not allowed to lie upon the lambing ground. The lamb is fondly licked by the ewe at first, and during this process makes many fruitless attempts to gain its feet, but it is surprising how very soon after an easy birth it can stand; and the moment it does so, its first effort is to find out the teat, expressing its desire for it, by imitating the act of sucking with its lips and tongue, uttering a plaintive cry, and wagging its long tail. It is considered a good sign of health when a lamb trembles after birth. There are various obstacles to its finding the teat at first, the long wool on the ewe's flank hides it, the wool on the udder interferes with it, and what is still more tantalizing to the anxious toper, the intense fondness of its own mother urges her to turn herself to fondle it with her mouth—uttering affectionate regards—but the motion has the effect of removing the teat, the very object of its solicitude. When at length a hold of what it wants is attained, it does not easily let it go until satisfied with a good drink. When a fond ewe has twin lambs, one can easily obtain the teat, while she is taken up in caressing the other. This is the usual conduct of strong lambs; and on once being filled with warm milk, progress rapidly to increasing strength, and are soon able to bear very

rough weather. But lambs after a protracted labour, or the first lamb of young ewes, are so weakly at first as to be unable to reach the teat by their own strength, when they must be assisted, and the assistance is given in this way. Turning the ewe over upon her rump, the shepherd reclines her back against his left leg, which is bent, while he supports himself kneeling on the right one. Removing any wool from the udder by the hand, and which is all that is necessary, without *clatting* or *doddering*, as it is called in Scotland, he first presses the wax out of the teats, and then takes a lamb in each hand, by the neck, and opens the mouth with a finger, and applies the mouth to a teat, when the sucking proceeds with vigour. A young ewe, or gimmer, is apt to be shy to her first lamb, but after she has been suckled, either in this or in the natural way, she will never forsake her offspring. Indeed, it is a good plan for a shepherd to give every lamb its first suck in this way, as it not only saves *it* much trouble, and puts it in the way of gaining strength rapidly, but affords himself a favourable opportunity of examining the state of the udder, whether it is in a proper state for yielding milk, or feels hard, or is inflamed. The proper treatment of the udder, when in an inflamed state, will be found below. Gimmers have so scanty a supply of milk, that it is expedient for the shepherd to support their lambs partially on cow's milk, until they can afford the requisite supply, which will be induced partly by suckling, and partly from new grass. When the shepherd has lambs to support for a short time, he should supply them with milk at regular times, such as in the morning and evening, and see that the lambs are suckled by their mothers during the day, and thus endeavour to bring on a sufficiency of milk. The dairy-maid should put the cow's milk for the shepherd in bottles, at the hours when the cows are milked, in the morning and evening, and he administers it to young lambs while warm from the cow, and it is done in this way: Sitting down, let him take a mouthful of milk from a bottle, and holding up the open mouth of the lamb, he pours the warm milk into it in a small stream from his mouth; and thus mouthful after mouthful until the lamb is filled. This auxiliary supply of milk should be withheld the moment the ewe can support her lambs herself, for cow's milk is not so congenial to a lamb's constitution as that of its own mother. The ewes are kept on the lambing ground till they have completely recovered from the effects of lambing and the lambs have become strong, and the ewes and lambs have become well acquainted with each other. The time required to accomplish this depends on the nature of the lambing, and the state of the weather. The ewes, with their lambs, are then put into a field of new grass, where the milk will flush upon

the ewes, much to the advantage of the lambs. It is generally a troublesome matter to drive ewes with young lambs to any distance to a field, because of the ewes always turning round and bewildering the lambs. A dog more frequently irritates the ewes than assists the shepherd in this task. I believe the best plan is to lead the flock instead of driving it, by carrying a single lamb, belonging to an old ewe, by the fore legs, which is the safest mode of carrying a lamb, and walking slowly with it before the ewe, while she will follow bleating close at the shepherd's heels, and the rest of the ewes will follow her of course. If the distance to the field is considerable, the decoy lamb should be set down to suck and rest. With plenty of food, and a safeguard of net and lantern at their lair at night, to keep off the foxes, the flock will not fail to thrive apace. In case this safeguard is not adopted, and which I believe is rare, it may be proper to tell you the distinctive marks of the attacks of a dog from that of foxes on a lamb flock. The fox always attacks a lamb on the neck behind the head, and, if scared from his purpose, distinct holes made by the teeth will be found on each side of the neck, whereas a dog seizes any part of the body, and worries by the under part of the neck. Some ewes will fight off either dog or fox, and be able to protect a single lamb; whilst others become so frightened at once from an attack, that they do not know whither to flee for refuge. After such an attack, the bleatings of the ewes and lambs in search of each other, which is an unusual occurrence at night, will soon acquaint the shepherd that some disaster has happened to his flock. The fox, if not immediately disturbed, carries off his prey, while the dog worries and leaves behind him what he does not eat.

(2372.) All the preceding cases of lambing are easy to the shepherd, but others usually occur which put his skill to the test. Malformations of the body of the lamb create difficult parturition, and endanger the life of the ewe. It is almost impossible to bring the head of a wry-necked lamb into the passage of the womb, but it must be done before the entire body can be extracted, and if not, the head of the lamb should be taken off rather than the ewe should lose her life. Sometimes twin lambs die in the womb several days before the period of lambing, and as they cannot present themselves to the birth, they must be extracted by force, or even cut away in pieces, or they may be pulled away in pieces. In such a case the placenta will be corrupted, and it may be a considerable time before it is entirely got rid of by the ewe by pressing. I have seen it so corrupted that it came away in discharges from the ewe as black and as viscid as tar. When twins are about to be lambed, the only care required is to ascertain that each is presented separately.

A breech presentation is a difficult one, and the extraction is impracticable until the hind-legs are first brought out; and in extracting by the breech, the operation should be done quickly at the last to prevent the lamb drowning in the liquor amnii. In all cases of extraction, it should be made a point to have the back of the lamb next to the back of the ewe.

(2373.) Much trouble is experienced by shepherds when ewes will not take their own lambs. A ewe that beats off her own single lamb and endeavours to purloin one from another ewe, should be immediately put into the shed and confined to a spot by a short string tied above the fetlock joint of one of her fore legs to a stub driven into the ground. When she endeavours to leave her lamb, the string pulls her foot off the ground, and while her attention is taken up with the string, the lamb seizes the teat and sucks in the mean time. This stratagem often repeated takes the courage from her, and makes her take with the lamb. In every case of a ewe refusing to let her lamb suck, the shepherd should particularly examine the udder, and see there is no inflammation or uneasiness in it; and if there is, he should endeavour to remove it before putting the ewe under discipline. It is surprising how soon a lamb learns to steal a suck from a ewe; if it cannot approach by the flank, it will seize the teat from behind between the hind legs. When a ewe will allow but one of her twins to suck her, she should be held till both suck her, and in a little time she will take with both. It is not surprising that one ewe should refuse to take the lamb of another; and yet it is necessary when a lamb is left an orphan, or is a supernumerary, to *mother* it, as it is termed, upon another ewe. For example, when a gimmer that has little milk has twins at a time when another ewe that has plenty of milk produces a single lamb, it is for the benefit of both ewe and lamb, that the ewe which has plenty of milk should bring up two lambs; and the transference is easily enough accomplished while all the lambs are still wet, and two of them are placed before the ewe at once; but when a ewe does not die till two or three days after she has lambed, it will be difficult to make another ewe that lambs a single lamb, as the other ewe dies, take the older lamb along with her own. The usual plan, in such a case, is to rub the body of the older lamb with the new dropped one, before the new lambed ewe has had an opportunity of recognising her own lamb, and to place both before her at the same time; and she *may* take both without scruple; but the probability is, that she will reject the older one, when she should be put into a dark corner of the shed and confined in it by a board placed across the corner, only giving her room to rise up and lie down, and to eat, but not to turn quickly round

upon the stranger lamb, which, rubbing against her wool, and sucking her against her inclination, will soon acquire the odour of her own lamb, and ingratiate itself in her favour. Another case of difficulty is, when a twin lamb dies at birth from a ewe that has plenty of milk, while another ewe has had twins and is unable to support them; and the expedient is, to strip the skin immediately off the new-born dead lamb and sew it on the body of one of the lambs belonging to the other ewe, and present both the foster-lamb and her own at the same time to the ewe that has plenty of milk. It is probable that the dark corner will require to be used before a cordial reception is given to the foster-lamb. Should all the above expedients fail to *mother* the lambs upon the ewes; and they *may* fail, though, under the guidance of a skilful shepherd, they seldom do, the lambs should be taken away and brought up as *pets* on cow's milk.

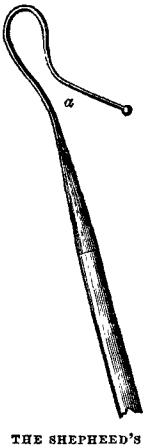
(2374.) The lamb of a *fat* ewe is always small when lambed, and is plump and lively, but the ewe in that state runs a great risk in lambing of inflammation in the passage of the womb. A *lean* ewe bears a lamb large in the extremities, and thin and weak in the body. A very *old* ewe's lamb is both small and weak. The lamb of a *gimmer is* small, and she not having sufficient milk to rear it, continues small; and the lamb of a hogg is still worse off. The best plan of managing ewes for rearing good lambs, is to keep them always in fair condition in winter, and until they have lambed, after which event they should have the best grass the farm can afford. New grass always produces abundance of milk, and it springs earlier than old. In case of snow covering the ground in spring, when the ewes are heavy in lamb, they should get a few turnips and plenty of hay, and clover-hay if possible, until the ground is again clear; but in open weather in winter, there is nothing better for them than grass which had been kept rough for the purpose in autumn. While confined on the lambing-ground, ewes should have turnips and hay to support them; and after lambing, there is nothing better for them than cabbage or kale, in default of which a little oil-cake will encourage, at that time, the necessary discharges and purify the body. New grass also operates medicinally on the system.

(2375.) It is necessary to say a few words on the rearing of *pet lambs.* Wherever these are there must be orphans or supernumeraries in the flock, and, in either case, the deserted creatures would die were they not reared by hand. As a remarkable instance of lambs being obliged to be made pets from supernumerary births, I remember one season, in a small flock of Leicester ewes, 50 in all, 48 having twins, and 2 trines. The two lambs which constituted the trines were properly taken away to

relieve the ewes, and brought up by hand as pets. When ewes die it is scarcely possible avoiding having pets, on account of the improbability of ewes lambing single lambs just in time to receive those that have become orphans. Pet lambs are supported on cow's milk, which they receive warm from the cows each time they are milked, and as much as they can drink. In the intervals of meals, in bad weather, they are kept under cover, but in good weather they are put into a grass paddock during the day, and under shelter at night until the nights become warm. They are fed by hand out of a small vessel, which should contain as much milk as is known each can drink. They are first taught to drink out of the vessel with the fingers like a calf (2110.), and as soon as they can hold a finger steady in the mouth, a small tin tube, about 3 inches in length, and of the thickness of a goose quill, should be covered with several folds of linen, sewed tightly on, to use as a substitute for a teat, and by which they will drink their allowance of milk with great ease and celerity. A goose quill would answer the same purpose, were it not that it is easily squeezed together by the mouth. When the same person feeds the lambs, and this should be the dairy-maid, the lambs soon become attached to her, and would follow her every where; but to prevent their bleating, and to make them contented, an apron or a piece of cloth, hung on a stake or bush in the paddock, will keep them together.

(2376.) A very common method, practised by shepherds of Leicester sheep, when they wish to catch a ewe to give a weakly twin lamb a suck, or to examine the state of her udder, is to stoop down and run in upon her from behind and seize her by a hind leg. This is a safe enough mode of catching a sheep when dexterously done; but when it fails, that is, when the captor cannot keep himself out of view until he seizes the ewe, she will start and run off, and alarm the other ewes beside her, and every alarm to a ewe, whether lambed or about to lamb, is injurious, and, at any rate, cannot do any good. In these circumstances, a *crook* does the same thing more quietly and as securely. It consists of a round rod of iron, bent in the form shewn in fig. 397, furnished at the point with a knob, that the animal may not be injured by a sharp point, and at the other end with a socket, which receives a long shaft of wood, 5 or 6 feet long, according to fancy. The hind-leg is hooked in at *a*, from behind the sheep, and it fills up the narrower part beyond *a*, while passing along it until it reaches the

Fig. 397.



THE SHEPHEED'S CROOK.

loop, when the animal is caught by the hock, and, when secured, its foot easily slips through the loop. Some caution is required in using the crook, for should the sheep give a sudden start forward to get away, the moment it feels the crook, the leg will be drawn forcibly through the narrow part, and strike the bone with such violence against the bend of the loop as to cause the animal considerable pain, and even occasion lameness for some days. On first embracing the leg, the crook should be drawn quickly towards you, so as to bring the bend of the loop against the leg as high up as the hock, before the sheep has time even to break off, and being secure, its struggles will cease the moment your hand seizes the leg.

(2377.) When those male lambs which are not to be kept as tups attain the age of from 10 days to a month, they are *castrated*. Some breeders advocate castration in a day or two after birth, whilst others will not allow the operation to be performed until the lamb is one month old. My opinion is, that both these periods are extremes. A lamb of a day old cannot be confirmed in all the functions of its body, and indeed in many instances I question whether the testicles can then be found. At a month old, on the other hand, the lamb may be so fat and the weather warm, that cutting may be attended with febrile action. I prefer the operation being performed at from 10 to 15 days, when the creature has attained some strength, and yet its parts have not yet become rigid. Castration is performed in this way. Let the assistant hold the body and both legs, one in each hand; as represented in fig. 398. The shepherd then causes the testicles to press the scrotum *a* smooth; and making an incision through the integuments of the scrotum to the testicles, he pushes out one testicle farther than the other, seizes it with his teeth, and draws out the spermatic cord until it breaks, and does the same with the other testicle, when the operation is finished. Advantage is taken of the opportunity to dock the tails, which is left at *c* as long as to reach to the meeting of the hams. In performing docking, the division should be made in a joint, otherwise the portion of the vertebra which has been cut through will have to be sloughed off before the wound can heal. Ewe lambs are also docked at this time, but they are not held up for the operation, being merely caught

Fig. 398.

THE CASTRATION OF LAMBS.

and held until it is done. In England, docking is performed at the third joint, which leaves a mere stump of a tail. The male lamb, after being docked, is let down to the ground by the tail, which has the effect, it is said, of righting the parts about the scrotum after castration. The same opportunity is taken to mark the ears of lambs, and in the case of stock in hill farms, where it is not easy to gather flocks frequently, the operation is now easily performed; but as Leicester lambs are not marked in the ear at this time, I shall defer describing that operation until its proper season in summer. The scrotum does not bleed in castration, but the tail sometimes bleeds for a long time in two minute and forcible streams, though usually the bleeding soon stems. Should it continue so long as to sicken the lamb, a small cord should be tied firmly round the end of the tail, but this must not be allowed to remain on above 24 hours, as the point of the tail would slough off. The object of docking is to keep the sheep behind clean from filth and vermin; but as the tail is a protection against cold in winter, it should not be docked too short, as is the case in England. Tup-lambs are allowed to retain their full tails until a year old, in order to strengthen the back. Great caution is required in castrating lambs; it should not be done in rainy weather, nor in very cold weather, nor in frost; nor should the lambs be heated before the operation. It is best performed early in the morning, in fresh weather, with a westerly breeze. The ewes and lambs should be driven gently to a corner of the field, but not by the dog, whose duty is only to prevent a ewe breaking away. One assistant should catch the lambs, and another hold them while the shepherd operates. It is not easy to catch a lamb with a sheep's crook, their small active limbs easily escaping from the loop, but it may be effectually used in hooking the neck, when the captor runs in upon the lamb and secures it. Where there is a bught or open shed in a field, the lambs and ewes may be driven loosely in, and the lambs captured there. The old fashioned mode of castrating lambs, is to cut off the point of the scrotum, and extract both testicles by the large incision; but the extensive wound thus made takes a considerable time to heal, whereas the simple incision now made heals almost always by the first intention. In some cases, however, inflammation ensues, and the scrotum swells, and even suppurates, when the wound should be carefully examined, the matter discharged, and the wound soon heals up. The operation should always be done in the morning, that the several cases may be observed during the day; and should the weather have changed for the worse towards the afternoon, the ewes, with the lambs that have just been cut, should be brought into shelter all night. Besides the state of the weather, one cause of

inflammation is the scratching of the wound of the scrotum by the points of the stubble amongst the new grass, and this irritation is most likely to be induced when the castration has been performed by cutting off the point of the scrotum. To avoid this source of irritation, the new cut lambs should be put into a field of new grass where the stubble is short, or into a field of old grass for a few days. Hill lambs should be driven the night before being castrated into a bught or enclosure where they will be ready and cool for the operation in the morning. The practice of applying turpentine to the incision on the scrotum gives unnecessary pain and serves no good purpose. Sometimes one of the testicles does not descend into the scrotum, in which case the lamb becomes what is called a *chaser*, that is, one who constantly chases the females of the flock, when near him, from morbid desire.

(2378.) These are the various risks which ewes and lambs are subject to, until they may be said to be beyond danger; and when they have passed through these several trials in safety, the shepherd may calculate on the result of his success,—he may then endeavour to ascertain whether he has increased the breeding part of his flock in the proportion it should have increased. He should not be satisfied with his exertions, unless he has preserved one-half the number of ewes with twin-lambs, nor should he congratulate himself, if he has lost a single ewe in lambing. I am aware these results cannot always be commanded, but I believe an attentive and skilful shepherd will not be satisfied for all his toil, night and day, for three weeks, if he has not attained these results. The ewes may have lambed twins to greater number than the half, and yet many pairs may have been broken to supply the deficiencies occasioned by the deaths of single lambs. The death of single lambs is a vexatious matter to a shepherd, as it not only breaks his pairs, but imposes very considerable trouble on him in *mothering* the severed twins upon other ewes; and yet the trouble must be undertaken to retain the ewes that have lost their lambs in milk, and so maintain them in proper condition for future years. In fine steady weather, the shepherd proceeds with his labour in comparative ease; but when stormy or wet weather prevails, or comes at unexpected intervals, the number of lambings are not only accelerated, but every ewe most probably creates some trouble even in the day time. True, "daylight has many eyes," and permits him to observe many casualties in time to remedy their effects; but at night, in bad weather, with glimmering light, difficulties increase tenfold, and so sensibly have I witnessed these difficulties myself, I am convinced every farmer of a large flock would find it repay him at the end of the lambing season, in the increased number of preserved lambs and ewes, to af-

ford the shepherd assistance *at night* in the most busy period of the lambing season, according to the circumstance of the case. In regard to Cheviots, it is considered a favourable result to rear a lamb for each ewe; and with Black-faced ewes, 18 lambs out of the score of ewes is perhaps one as favourable. Cheviots yield a few pairs, Black-faced very few. The former sometimes require assistance in lambing, the latter seldom.

(2379.) The state of the new grass-fields occupied by ewes and lambs requires consideration. Ewes bite very close to the ground, and eat constantly as long as the lambs are with them; and as they are put on the new grass in the latter part of March, before vegetation is usually much advanced, they soon render the pasture bare when overstocked, and the weather is unfavourable to vegetation. In cold weather in spring, bitten grass soon becomes brown. Whenever the pasture is seen to fail, the ewes should be removed to another field, for if the plants are allowed to be bitten into the heart in the early part of the year, the greater portion of summer will elapse ere they will recover from the treatment. In steady growing weather there need be little apprehension of failure in the pasture. The sown pastures consisting chiefly of red clover and rye-grass, the clover is always acceptable to sheep; and in the early part of the season young shoots of rye-grass are much relished by ewes. On removing the stock from the first to the second field, it is better to eat the first down as low as it safely can be for the plants, in order to *hain* it, that is, to leave it for at least a fortnight, to allow the young plants to spring again with vigour, and which they will do with a much closer bottom than if the field had been pastured for a longer time with fewer stock. Such a field eaten down to the end of May, or beginning of June, and allowed to spring afterwards in fine growing weather, will yield a much heavier crop of hay, than if it had not been depastured in spring at all. Although the whole breadth of young grass on a farm pastured lightly with ewes and lambs in the spring were to grow, as the season advances more rapidly than the ewes could keep it down, it will never produce the fine sweet fresh pasture which field after field will yield that has been eaten down in succession, and then entirely hained for a time. But in removing ewes and lambs from a short to a full bite of grass, considerable caution is requisite in choosing the proper time for the removal. It should be accomplished in dry weather, and in the afternoon; because, continued damp or rainy, or cold wet weather, renders new grass so succulent and fermentable as almost certain to produce the *green skit* in lambs that are put upon it, although the damp weather should increase the ewes' milk.

(2380.) Carse farms have neither a standing nor a flying stock of ewes, and, consequently, have no lambing season; neither have farms in the neighbourhood

of large towns, nor dairy farms, nor pastoral ones for the breeding of cattle; so that ewes and lambs are only found on pastoral farms that are devoted to the breeding of sheep, and on farms of mixed husbandry. But pastoral farms rear breeds of sheep very different in their nature from the breed, the management of which, in the lambing season, I have endeavoured to describe, and a ewe and lambs of which may be seen in Plate XIV. On our hills the Cheviot and Black-faced, or Heath sheep, were long the only inhabitants, but now the valuable Southdowns are added to the list. The Cheviot and Southdown range along semi-upland green mountain pastures, such as the Downs and the green hills of Cheviot, in England, and the green hills of Ochils, Sidlaws, and the Lammermuir group, which stretches across the south of Scotland; while the Black-faced roam on the highest mountains, not only as far as a plant of heath can grow, but even beyond it, in the region of the cryptogamiæ.

(2331.) In as far as the assistance of the shepherd is required to be given to ewes in the act of lambing, the observations I have made in reference to the lambing of Leicester ewes will apply to those of the Cheviot, Southdown, and Blackfaced breeds; but the ewes of these breeds do not require assistance nearly to the same extent as Leicester ewes, the lambs of the latter being generally larger in proportion to the ewes, and they are more square-built in form. Single lambs of the other breeds are generally brought forth without any assistance, and twin-lambs are so few, that the ewes bearing them may be singled out for remarkable attention. A Cheviot single lamb soon gets on foot after being lambed, and its acute instinct as soon directs it to the teat. The Black-faced lamb is fully more active after being dropped, gaining its feet in a few minutes, and its rough coat of wool serves to protect it at once from the weather. Placed in shelter derived from one of the many natural inequalities of the ground common in a pastoral country, both these breeds may easily be tended in the lambing during the day; but the constant attention required of the shepherd limits his ability to superintend, at this particular period, a lambing flock beyond a certain number: 400 ewes are as many as one shepherd can superintend in the course of the day, to render them the assistance they may stand in need of; to see that the new lambed ewes and lambs are placed in shelter until they have both perfectly recovered, and are able to take to the pasture; and, in case of bad weather, to see that the ewes are supplied with some turnips and hay, to enable them to support their lambs until the weather becomes favourable. If one shepherd fulfils these duties in the day, he does quite enough, so that it will be necessary to have an assistant for him in the night, to see that the ewes are gathered into the shelter at nightfall, and to take a weakly lamb, or all the lambs that have dropped during the night, into sheds erected on purpose as a protection against bad weather. To ascertain the state of his flock, he should go through them with a lantern, at least every two hours, and oftener if necessary. Lord Napier recommends the construction of a "*lambing park*," for the use of ewes, and gives the cost of making one to comprehend 25 acres of ground, which shall accommodate 200 ewes, with 2 stells and 2 stell-houses, and hay-racks, at L.90, which, at 7 per cent. interest, with repairs of racks, &c., will incur an annual cost of L.7 : 5 : 8, for 1000 sheep.* Such a place of shelter and of enclosure would, no doubt, be useful to a certain extent, but only to a limited extent; for such a park can only be in one part of the grazings, where at times it will no doubt be exposed to the weather, and as 25 acres would only contain $\frac{1}{2}$ of

* Napier on Practical Store Farming, p. 155.

the flock at a time, in stormy weather the rest of the flock, whether already lambed or yet to lamb, require shelter as well as ewes expected to lamb; and the dividing of the flock every day to get the 200 ewes with their lambs out, and other 200 driven in, would make a serious commotion amongst them at a very critical period of the ewes. I cannot help thinking that a chosen spot, selected to afford shelter, according to the circumstances of the weather, to all the ewes yet to lamb within a given time, and where they could be partly supported on artificial food, whilst those which have lambed could occupy at night a sheltered part of the best portion of the pastures, would disturb lambing ewes far less than a lambing park which was not constantly occupied by all the ewes. It should be remembered that hill sheep cannot be so easily shifted from one place to another as Leicester sheep, and especially in a grazing which has few or no enclosures. Small pieces of English blanketing, to be kept dry when not in use, to wrap round and keep warm a weakly lamb in the shed, until it has recovered by the effects of its mother's milk, or of warm cow's milk administered by the shepherd, will be found a useful article by every shepherd, and may be the means of preserving the life of many a lamb. Many a lamb I have seen recruited by this means, when it would have otherwise perished of inanition. The period of lambing, in hill sheep, is longer than that of Leicester, because the gimmers are not tupped in the autumn until a fortnight after the ewes, and, of course, do not begin to lamb in the spring until a fortnight later. The ewes begin to lamb about the 20th April, and the gimmers a fortnight after. To strengthen the gimmers, and to bring a flush of milk upon them, they are separated from the ewes about a month before *their* lambing time, and are supplied with turnips to the amount of a double horse-load, say 15 cwt., to every 100 or 120 gimmers. About a fortnight before the ewes lamb, they get the same quantity of turnips for every 160 ewes. In mountain farms, where there are no turnips, hay should be supplied in the same manner to the gimmers and ewes. A quantity of hay, expended at this time, will be more than repaid in the safety of lambs and vigour of ewes, especially in unfavourable weather.

(2382.) These few observations of Mr Little on the qualifications of a *hill shepherd*, are worth your attention, as containing much good practical sense and truth. "Much," he truly says, "of the success in sheep-farming depends on the skill and application of shepherds, as well as on the judgment of farmers. As the situation of a shepherd is one of considerable trust, he ought to be honest, active, useful, and of a *calm temper;* for if at any time a shepherd gets into a passion with his sheep, it is attended with great disadvantage in herding, or in working among them. I have known a hasty passionate man, with a rash dog, give himself double the trouble in managing a hirsel of sheep, besides abusing the sheep, that a calm good-tempered man, with a sagacious close-mouthed dog, would have had in the same circumstances. The qualification required in taking care of a hirsel of sheep, is, not in running, hounding, and training dogs, nor in performing a day's work of any other kind; but to direct them according to the soil, climate, and situation of the farm, in such a manner as to obtain the greatest quantity of food at all seasons of the year. Their health and comfort should be carefully looked after by the shepherd; and if his exertions are made with judgment, they are of very great consequence to the farmer. It is not by walking much, and doing a great deal, that a shepherd is a good one; but it is knowing *where* to walk, so as to disturb the sheep the least, and by doing at the time whatever is necessary to be done. There is

not an experienced shepherd who has been any length of time on one farm, who does not, as soon as he rises in the morning, and observing the state of the weather, know almost to a certainty where to find every sheep on the hill, and will accordingly take his course to the places he knows his presence is most wanted. The object in looking over a hill every evening and morning, is to ascertain if there be no trespassers nor diseases among the sheep which require looking after. If any of your own or neighbour's sheep have trespassed, it is very foolish to dog or abuse them, for the more gently you can turn them back the better. If the boundary should be on the top of a height, to which sheep are apt to draw at night, it is better to turn your own a little closer to the boundary in the afternoon, than to turn back your neighbour's; and it will answer the same purpose; and if the two flocks are gently divided in the morning, without dogs, they will become so well acquainted with their own side, that at the very sight of the shepherd they will take to it without farther trouble. Those shepherds who dog, force, and shed much about a march, I consider them as bad herds for their masters as for the neighbouring farmer. If the boundary be a brook or low ground, where the sheep graze in the middle of the day, and if trespasses are likely to be considerable, the same plan of turning the sheep should be taken as on the height, except that they are to be turned down in the morning, and set out in the afternoon. When a sheep dies on the hill, or any disease appears among them, the dead or diseased sheep should be removed immediately, but particularly so if the disease appears of an infectious nature. Looking regularly over a hill is of great consequence, also, in case of any sheep falling into a ditch, or lamb losing its mother, or when they are annoyed by flies or maggots, or by foxes or dogs worrying them, or when they fall on their back and cannot get up again. All these incidents an active shepherd with a good eye will soon discover, however much a flock may be scattered over a farm. . . . In good weather the shepherd may possibly do all that can be done among the ewes in the lambing season; but in bad weather it is the farmer's interest to afford every necessary assistance, for the want of which, serious losses have often been incurred. . . . Knowing sheep by head-mark often saves a shepherd much trouble, particularly in the lambing season, and at all sortings of the sheep; yet there are many good shepherds who do not know sheep by head-mark, and there are some very ordinary ones who have a talent in that way. Every individual may be known by the *stock* mark. To possess the knack of *counting* sheep readily is of no small service to a shepherd, for he ought always to be able to count his flock when he makes his rounds on the hill. There are few shepherds who accustom themselves to count sheep, who cannot, wherever they meet with them on a hill, count 100 going at large, or even 200, and it seldom happens that a greater number than 200 will be found together in an open hirsel. To know the number in the different lots is of great use in case of a hasty blast, as you can, in that event, know almost to a certainty, whether or not any sheep are awanting, and from what part of the farm. A shepherd ought likewise to be able *to do any kind of work about a sheep farm*, such as cutting lambs, smearing, slaughtering, dressing for the market, repairing stone-dykes, cleaning out drains, mowing grass, making hay, casting and winning peat-turf for fuel, &c.; but he ought at no time to neglect the sheep for such work. Shepherds are generally accounted lazy, but those who really care for their sheep will not be so. Much walking unfits a man for hard labour, as much as hard labour unfits a man for much walking; but la-

bourers will generally be found more lazy in a hill, or among sheep, than shepherds will be found at field-work."*

(2383.) Ewes in lamb are liable to abortion, or *slipping of the lamb*, as it is usually termed, as well as the cow, but not so much so, nor is the complaint considered epidemical in the sheep. Various causes produce it, such as severe weather in winter, having to endure much fatigue in snow, leaping ditches, being frightened by dogs, over-driving. It is stated by Mr Youatt, that too liberal use of salt will produce abortion. The wool is apt to come off in spring after abortion. It is scarcely possible to predicate abortion in sheep on account of their woolly covering, but its immediate effects of dulness in the ewe, and of a redness under the tail, will be symptoms noticed by an observant shepherd. "The treatment after abortion," observes Mr Youatt, "will depend entirely on the circumstance of the case. If the fœtus had been long dead, proved by the fetid smell of it, and of the vaginal discharge, the parts should be washed with a weak solution in water (1 to 16) of the chloride of lime, some of which may also be injected into the uterus. If fever should supervene, a dose of Epsom salts, timeously administered, will remove the symptoms. If debility and want of appetite should remain, a little gentian and ginger, with small doses of Epsom salts will speedily restore the animal. Care should be taken that the food shall not be too nutritive or too great in quantity." In protracted labour when the ewe is becoming weak, she will be much relieved by receiving a table-spoonful of brandy and sweet spirit of nitre in equal parts, with a drinking-horn. To produce pains in a ewe when she becomes apathetic in lambing, 2 table-spoonfuls of a strong infusion of the ergot of rye, repeated in a second dose in a quarter of an hour, will produce pains and ease the labour. In cases where it is impossible to extract the lamb, and the life of both lamb and ewe are in danger, the Cesarian operation, that is, extracting the lamb from the womb by an incision made in the side and in the womb of the ewe, has been performed with success. "In some lambs that are born apparently dead, the vital principle is not extinct, but it would soon be so if the little animal were suffered to remain on the cold damp grass. Every lamb that is found in this situation should be carefully examined, and if there is the slightest degree of warmth remaining about it, the shepherd should blow into its mouth in order to inflate the lungs: many a little one has thus been saved. The shepherd need trouble himself very little about the expulsion of the placenta or *cleansing*, although a day or two may pass before it is detached. A couple of ounces of Epsom salts, with a little ginger, may be given if there should be a longer delay, or if symptoms of fever should be exhibited; but the farmer would do well to avoid the rough barley or the misletoe, or in fact any stimulant, for there is at this time sufficient disposition to fever, without its being artificially set up." "The inflammation of the womb, after parturition, usually comes on between the first and the fourth day, and especially when any violence has been used in extracting the lamb. It is a most fatal disease, and speedily runs its course. The treatment should be bleedings and purgatives of Epsom salts. Connected with this disease are after-pains or heaving, to which ewes are subject, and which are frequently severe and destructive. They are apparently the same pains, but considerably stronger, which nature uses to expel the lamb. It is evidently produced by the ewes being too well kept during their pregnancy. It cannot be

* Little's Practical Observations on Mountain Sheep, p. 79-86.

too often repeated, that it is a fatal error to overfeed the ewes at this period, with the view of giving them strength to support their approaching labour. It is a most unscientific and injurious practice, and severely does the farmer suffer for it. But there is some epidemic influence at work, or the constitution of the sheep is at that time irritable almost beyond belief." Young lambs, as long as they are dependent on their mother for food, are subject to few diseases. A change to new luxuriant grass in damp weather may bring on the *skit* or diarrhœa, and exposure to cold may produce the same effect. As long as it feeds and plays there is little danger; but should it appear dull, its eyes watery and heavy, and its joints somewhat stiff, remedial means should immediately be used. "A gentle aperient is first indicated in order to carry off any offensive matter that may have accumulated in and disturbed the bowels; half an ounce of Epsom salts, with half a drachm of ginger, will constitute the best aperient than can be administered. To that must be added a table-spoonful of sheeps' cordial, consisting of equal parts of brandy and sweet spirit of nitre, housing and nursing." But there is a species of apparent purging, which is a more dangerous disease than the skit. "In the natural and healthy state of the milk and the stomach, curd produced by the gastric juice gradually dissolves and is converted into chyme; but when the one takes on a morbid hardness, and the other may have lost a portion of its energy, the stomach is literally filled with curd, and all its functions suspended. The animal labours under seeming purging, from the quantity of whey discharged, but the actual disease is constipation. It is apt to occur about the time when the lamb begins to graze, and when the function of the stomach is naturally somewhat deranged. Chemistry teaches us, that while a free acid produces coagulation of the milk, an alkali will dissolve that coagulum. Magnesia, therefore, should be administered, suspended in thin gruel, or ammonia largely diluted with water, and with them should be combined Epsom salts to hurry the dissolved mass along, and ginger to excite the stomach to more powerful contraction. Read's stomach-pump will be found a most valuable auxiliary here. A perseverance in the use of these means will sometimes be attended with success, and the little "patient being somewhat relieved, the lamb and the mother should be moved to somewhat better pasture." Besides looseness, lambs are at times subject to costiveness in the bowels. In the first few days of its existence the fœces they void has a very viscid consistence, which, when it falls on the tail, has the effect of gluing it to the vent and of stopping up that passage. On the removal of the obstruction by scraping with a knife, the symptom will also be removed. A worse species of costiveness is, when a few drops of liquid fœces fall occasionally to the ground accompanied by straining, as it is generally accompanied with fever that may be dangerous. Half-ounce doses of Epsom salts should be administered every 6 hours until the bowels are evacuated, after which both ewe and lamb should be turned into more succulent pasture, as the cause of the complaint is to be found in bare pasture in dry weather. In cases of fever, which may be observed from the dulness of the lamb and its quick breathing, the administration of tolerable doses of Epsom salts will generally avert the malady *at its commencement*. After recovery from lambing, the only complaint the ewe is subject to is inflammation in the udder, or *udder-clap*, or *garget*. Of this complaint Mr Youatt gives a good idea of its origin and of its treatment in these words:—"The shepherd, and especially in the early period of suckling, should observe whether any of the ewes are restless and exhibit symptoms of pain when the lambs are sucking, or will

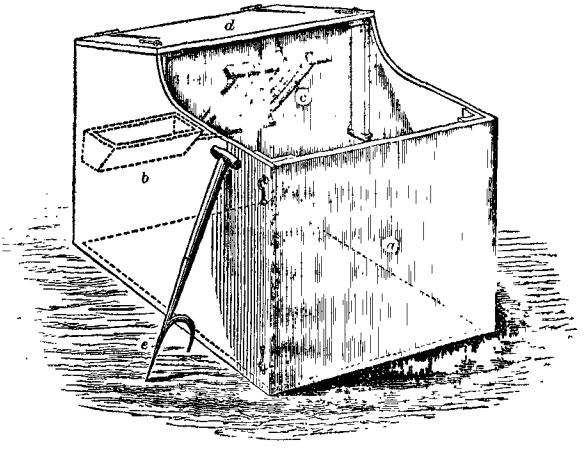
not permit them to suck at all. The ewe, like the cow, or oftener than that animal, is subject to inflammation of the udder during the time of suckling, caused either by the hardness or dryness of the soil on which she lies; or, on the other hand, by its too great moisture and filth, or by some tendency to general inflammation, and determined to the udder by the bumps and bruises, sometimes not a little severe, from the head of the lamb. If there is any refusal on the part of the ewe, or even disinclination, to permit the young one to suck, she must be caught and examined. There will generally be found redness and enlargement and tenderness of one or both of the teats, or sometimes the whole of the udder, and several small distinct kernels or tumours on different parts of the bag. The udder should be cleared of the wool which surrounds it, and should be well fomented with warm water, a dose of Epsom salts administered, and then, if there are no large distinct knots or kernels, she should be returned to her lamb, whose sucking and knocking about of the udder will contribute, more than any other means, to the dispersion of the tumour and the regular flow of milk. It may occasionally be necessary to confine her in a pen with her little one, in order that he may have a fair chance to suck. A day, however, having passed, and she not permitting it to suck, the lamb must be taken away, the fomentation renewed, and an ointment composed of 1 drachm of camphor rubbed down with a few drops of spirit of wine, 1 drachm of mercurial ointment, and 1 oz. of elder ointment, well incorporated together, must be rubbed into the affected part, or the whole of the udder, two or three times a day. She must also be bled, and the physic repeated. If the udder should continue to enlarge, and the heat and tenderness should increase, and the knots and kernels become more numerous and of greater size, and some of them should begin to soften or evidently to contain a fluid, no time must be lost, for this disease is abundantly more rapid in its progress in the sheep than in the cow. A deep incision must be made into that part of the udder where the swellings are ripest, the pus or other matter squeezed out, and the part well fomented again. To this should succeed a weak solution of the chloride of lime with which the ulcer should be well bathed two or three times in the day. When all fetid smell ceases and the wound looks healthy, the friar's balsam may be substituted for the chloride of lime. The progress of disorganization and the process of healing are almost incredibly rapid in these cases, and the lamb may sometimes be returned to the mother in the course of a few days. There are particular seasons, especially damp and warm ones, when there is a superfluity of grass, in which garget is peculiarly frequent and fatal. Without warning, the udder swells universally with hardened teats, which sometimes bring on great inflammation, and if that is not stopped in the course of 24 hours, part, if not the whole, of the udder mortifies, and the mortification rapidly spreads, and the sheep dies."*

(2384.) In case of an individual ewe, of a large flock of a pastoral farm, straying a considerable distance from the shed erected to afford shelter to ewes, or has suffered in hard labour, or has a weakly lamb, or has twins which are apt to stray from her or she from them, or has been overtaken by a rude blast immediately after lambing, a contrivance to afford such ewes temporary shelter, especially under night, having been used by Mr Nicholas Burnett, Blaik Hedley, near Gateshead, with success, seems to deserve attention. It consists of an en-

* Youatt on Sheep, p. 497–515.

closure of boards, or a box, as seen in fig. 399, whereof *a* is the front, which removes by hooks at the sides to admit the ewe and her lamb within, and where

Fig. 399.



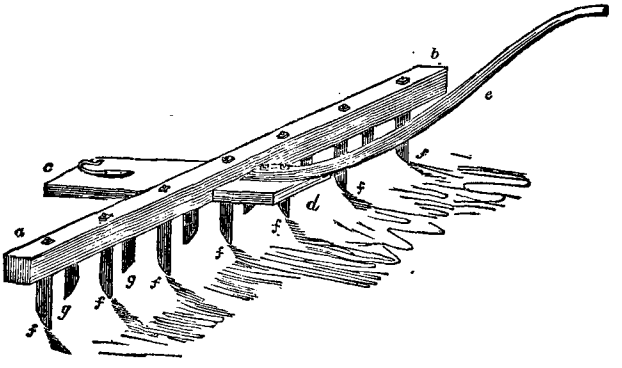
THE EWE-HOUSE.

she is provided with a manger *b* to contain sliced turnips or oil-cake, and a rack *c* for hay, to fill both of which access is obtained by the lid *d*, movable on its hinges. I have been assured by Mr Burnett, that in using this contrivance, which, being a light implement, can be easily carried to any spot, he has had the satisfaction of using it as a means of saving the lives both of ewes and lambs which would have otherwise perished from exposure. The size of the ewe-house, as it is called, may be made to suit that of the sheep bred on the farm, and as it is not costly, any number can be made to be used at a time. The fork *e* leaning against the side of the ewe-house may be used to grasp a ewe's neck, while lying on the ground, and to fasten it down, while the shepherd is lambing her without other assistance; but the method of holding a ewe between the heel and knee, which I have described above (2300.), renders such an instrument of little use.

(2385.) One of the greatest sources of loss among lambs on hill farms is a fall of snow at the lambing season, or a continuance of snow to that period. Ground rendered wet by the melting of new-fallen snow, is in a worse state for lambs than when made wet by rain, as in the latter case the temperature of the air is higher, though, of course, wet ground of any kind is inimical to the safety of new-dropped lambs. In such a case, the driest part of the farm, combined with shelter, should be chosen for the lambing ground, though it may be inconvenient in some other respects; but should the best lambing ground be covered with old snow, especially in sheltered spots, and the temperature of the air be generally above the freezing point, could the snow be stirred by any means, it would melt much faster than it would of itself. A *snow-harrow* or a *snow-plough* will be found a useful implement for the purpose, and those recommended by Mr Hepburn of Culquhalzie seem to possess every requisite. The snow-harrow is represented by fig. 400. It consists of a single bull *a b*, 4½ inches square, and

6 feet long; and in the middle of which, on the under side, a piece of $1\frac{1}{4}$-inch plank *c d*, 3 feet long, is sunk flush transversely, for the attachment of the

Fig. 400.

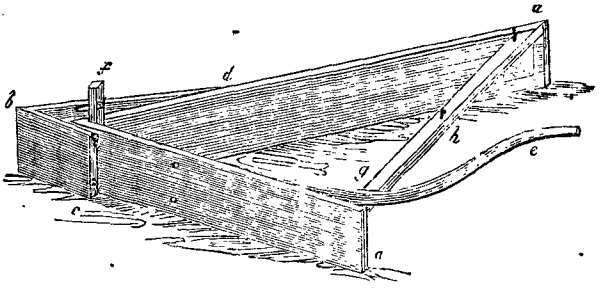


THE MOUNTAIN SNOW-HARROW.

draught-hook *c*, and the stilt *e* to steady the motion of the implement. In the bull are fixed, by screw-nuts at intervals of 10 inches, 7 cutters *f f*, &c., 9 inches long and $1\frac{3}{8}$ inch broad, sabre shaped, with their points turned backwards, so as to be less liable to be arrested by obstacles on the surface of the ground. Between these cutters are fixed 6 shorter ones *g g*, &c., 3 inches long, having their points turned forwards. This implement, dragged by one horse ridden by a boy, and the stilt held by a man, cuts the frozen snow into stripes of 5 or 6 inches broad, which are easily pulverized by the feet of the sheep, or divided by the snow-plough. The severe snow-storm of 1823 lay on the hills from February to May; and the protracted snow-storms of 1837–8, with repeated falls and alternations of frost and thaw, caused the death of many a sheep before and at the lambing season. The snow became so compacted in the latter year, that the common snow-plough was unable to penetrate the snow, and the common harrow to break its glazed surface. With the view of obviating both these inconveniences, Mr Hepburn contrived the snow-harrow described above, and also the snow-plough, of which the following is a description in Mr Hepburn's own words:—"The severity of the winter of 1837–8 in mountain sheep-pasture, led me to attempt the snow-plough, with or without the aid of the snow-harrow, for being applied in such situations. To enable the plough to clear tracks for the sheep along the hill sides, it is necessary it should be made to throw the snow wholly to the lower side. To effect this I caused to be fitted to the plough *a a*, fig. 401, the body of which forms an isoceles triangle whose sides are $7\frac{1}{2}$ feet, and its base 6 feet in length, the depth of the sides being 15 inches; a shifting head *b c d*, with unequal sides, one, *b c*, being 18 inches, the other, *b d*, 30 inches long, fixed by iron pins passing through two pairs of eyes as seen at *c*, attached to the head and to the sides of the plough respectively, so as to bring the point of the attached head of the plough nearly into the line of its upper side, or next the hill. The stilt *e* at the same time was made movable by a hinge-joint at its anterior extremity, fixed to the bottom of the head from the post *f*, so as to be capable of being fixed to the cross-bar or stretcher *g a*, either in the line bisecting the angle, as at *h*, which is the position for level ground, or in

the line, alternately, of either of the sides, *b a* or *b g*, when to be used on a declivity. The draught-chain is fixed, not to the shifting head, but to the upright

Fig. 401.



THE MOUNTAIN TURN-WRIST SNOW-PLOUGH.

frame-post *f*, in the nose of the plough, which rises 10 or 12 inches above the mould-boards. When the plough so constructed is to be worked along a declivity, with the left hand towards the hill, the shorter limb of the shifting head is fixed on the left side of the plough, near the point, and the longer limb on the right side, towards the middle; and the stilt being fixed in the left extremity of the cross-bar, nearly in a line with the temporary point, the plough is necessarily drawn in the direction of its left side, so as to throw the snow wholly to the right down the hill. When the plough is to return across the declivity, with its right side to the hill, the movable head is detached by drawing out the linch-pins, is turned upside down, and fixed in the reverse position; the shorter limb being attached to the right side, and the longer to the left side of the plough, while the stilt is brought to the right extremity *a* of the cross-bar. The plough is then drawn in the direction of the right side, and the snow is thrown wholly to the left, near the lower side. Should the lower side of the plough shew a tendency to rise, it may either be held down by a second movable stilt, fixed to the middle *b* of the cross-bar, or a block of wood, or other ballast weight may be placed on that side of the plough. The plough will be found to remove considerably more than its own depth of snow. When a plough of 1 foot high passes through snow 18 inches or 2 feet deep, very little of the snow falls back into the track, and what does so fall is easily cleared out by the plough in returning."* In lowland farms the snow remains around the fences long after the middle of the fields are clear. A speedy means of getting rid of the snow is to plough it with the common plough repeatedly. Had I not adopted this expedient in the spring of 1823, the oat-seed would not have been begun for a fortnight later than it really did.

(2386.) In regard to the treatment of sheep on turnips in spring, they are managed in the same way as in winter, until removed to grass, which they are, whenever the turnips fail, and are kept on for a short time until the weather becomes mild enough to have them shorn of their wool, and then they are sold to the butcher; but other farmers prefer selling them fat in a *rough* state off the turnips, that is, before the wool is clipped off them. The circumstances which regulate these different cases will be explained in a short time.

* Prize Essays of the Highland and Agricultural Society, vol. xiii. p. 191.

55. OF TRAINING AND WORKING THE SHEPHERD'S DOG.

"He was a gash an' faithful tyke,
As ever lap a sheugh or dyke,
His honest, sonsie, baws'nt face,
Ay gat him freends in ilka place.
His breast was white, his touzie back
Weel clad wi' coat o' glossy black;
His gawcie tail, wi' upward curl,
Hung o'er his hurdies wi' a swirl."

BURNS.

(2387.) The natural temper of the shepherd may be learned from the way in which he works his dog among sheep. When you observe an aged dog making a great noise, bustling about in an impatient manner, running fiercely at a sheep and turning him quickly, biting at his ears and legs, you may conclude, without hesitation, that the shepherd who owns him is a man of hasty temper. Most young dogs exhibit these characteristics naturally, and they generally overdo their work; and if you observe a shepherd allowing a young dog to take his own way, you may conclude that he also is a man who loses his temper with his flock. If you observe another shepherd allowing his dog, whether old or young, to take a range along the fences of a field, driving the sheep within his sight as if to gather them, you may be sure he is a lazy fellow, more ready to make his dog bring the sheep to him, than he to walk his rounds amongst them. Great harm may accrue to sheep by working dogs in these ways. Whenever sheep hear a dog bark that is accustomed to hound them every day, they will instantly start from their grazing, gather together, and run to the farthest fence, and a good while will elapse ere they will settle again. And even when sheep are gathered, a dog of high travel, and that is allowed to run out, will drive them hither and thither, without an apparent object. This is a trick practised by lazy herds every morning when they first see their flock, and every evening before these take up their lair for the night, in order to count them more easily. When a dog is allowed to run far out, he gets beyond the control of the shepherd; and such a style of working among wether sheep, puts them past their feeding for a time; with ewes it is very apt to cause abortion; and with lambs after they are weaned, it is apt to overheat them, and a considerable time will elapse before they recover their breath. Whenever a sorting takes place among the sheep, with such a dog they will be moved about far more than is necessary; and

intimidated sheep, when worn into a corner, are far more liable to break off than those treated in a gentle manner. A temperate herd works his dog in quite a different manner. He never disturbs his sheep when he takes his rounds amongst them at morning, noon, and night, his dog following at his feet as if he had nothing to do, but ready to fulfil his duty, should any untoward circumstance require his services, such as breaking out of one field into another. When he gathers sheep for any purpose of sorting, or of catching particular ones, the gathering is made at a corner, and to gain which he will give the sheep the least trouble, making the dog run out to the right and left, to cause the sheep to march quietly towards the spot; and after they are gathered, he makes the dog to understand that it is his chief duty to be on the alert, and with an occasional bark, prevent any of the sheep breaking away. When a sheep does break away and must be turned, he does not allow the dog to bite it, but only to bark and give a bound at its head, and thus turn it. In attempting to turn a Black-faced wether in this way, the dog runs a risk of receiving injury from its horns, and to avoid this, I have seen him seize the coarse wool of the buttock, and hang by it like a drag, until the sheep was turned round in the opposite direction, when he lets it go. In short, a temperate herd only lets his dog work when his services are actually required, he fulfilling his own duties faithfully, and only receiving assistance from his dog when the matter cannot be so well done by himself, and at no time will he allow his dog to go beyond the reach of his immediate control. Dogs, when thus gently and cautiously trained, become very sagacious, and will visit every part of a field where sheep are most apt to stray, and where danger is most to be apprehended to befal them, such as a weak part of a fence, deep ditches, or deep furrows into which sheep may possibly fall and lie *awalt* or *awkward*, that is, lie on the broad of their back and unable to get up, and they will assist to raise them up by seizing the wool at one side and pulling the sheep over upon its feet. Experienced dogs will not meddle with ewes having lambs at foot, nor with tups, being quite aware of their disposition to offer resistance. They also know full well when foxes are on the move, and give evident symptoms of uneasiness on their approach to the lambing ground. They also hear footsteps of strange persons and animals at a considerable distance at night, and announce their approach by unequivocal signs of displeasure, short of grumbling and barking, as if aware that those noisy signs would betray their own presence. A shepherd's dog is so incorruptible that he cannot be bribed, and will not permit even a known friend to touch him when entrusted with any piece of duty. So far as my observation extends, I think there are two varieties of the shepherd's

dog, one smooth, short-haired, generally black-coloured on the back, white on the belly, breast, feet, and tip of the tail, with tan-coloured spots on the face and legs; the other is a larger and longer-bodied animal, having long hair of different colours, and long flowing tail. In their respective characters I conceive them to be very like the pointer and the setter. The small smooth kind, like the pointer, is very sagacious, slow, easily broke and trained, and admirably suited to work in an enclosed and low country; the other, like the setter, is more swift, bold, ill to break, and requiring coercion, and fitter for work on the hills. The former answers the habits of Leicester sheep, the latter those of the Cheviot and Black-faced. The latter requiring a great range to work in, on account of the nature of the sheep and of the ground which they frequent, are bold and rough in action; still they should be trained to work with judgment and caution, and not with recklessness and fury. Most shepherds profess to be able to train young shepherds' dogs, and therein many display much ignorance of the nature of the animal, and of the aptitude of the particular animal for the peculiar work, and the consequence is, many dogs are rendered unfit for their work. Every shepherd's pup has a natural instinct for working among sheep, nevertheless they should always be trained with an old dog. Their ardent temperament requires subduing, and there is no more effectual means of doing so than keeping it in company with, and making it imitate the actions of, an experienced sober dog. A long string attached to the pup's neck, in the hands of the shepherd, will be found necessary to make it acquainted with the language employed to direct the various evolutions of the experienced dog while at work. With this contrivance it may be taught to "*hold away out by*," to "*come in*," to "*come in behind*," to "*lie down*," to "*be quiet*," to "*bark*," to "*get over the dyke or fence*," to "*wear*," that is, to intercept, to "*heel*," that is, to drive on, to "*kep*," that is, to prevent getting away; it will learn all these evolutions and many others in a short time, in imitation of its older companion and guide. It is supposed that the bitch is more acute than the dog, though the dog will bear the greater fatigue. Of the two, I believe, that the quietly disposed shepherd prefers a bitch, and is careful in working her as little as he can when in pup. I may mention, that the shepherd's dog claims exemption from taxation; and I believe that a well trained one costs at least L.3.

56. OF SOWING BARLEY-SEED.

"Such land as ye break up, for barley to sow,
Two earths at the least, ere you sow it bestow.
If land be thereafter set oating apart,
And follow this lesson to comfort thine heart."

TUSSER.

(2388.) It may be laid down as an axiom, that land which has borne turnips which have been eaten off by sheep should receive two ploughings of some sort before it is sown with *barley*. I have seen the experiment tried of sowing barley on a single furrow on land ranging from clay to gravelly, and the invariable result was, a manifest deficiency of crop compared to what had received two furrows; and this result is not surprising, when it is considered that barley requires a deep well pulverized soil to its perfect development, and that it is impossible to render any land so with a single furrow, that has been trampled firm by sheep, after carrying a heavy crop of turnips. Strong land yields, with a single furrow, a tough waxy clod, very inimical to the growth of barley; and light turnip soil, when ridged up with a single furrow, exhibits the growth of barley in drills corresponding exactly with the drills which had been manured for turnips. The least difference of crop with one and two furrows is observed on fine hazel loam, still the superiority is to be found with the two furrows. Lay it, therefore, down as a rule, that barley land shall receive two furrows; and the only question is in what form these should be given, bearing in mind, at the same time, that the land must be deep and well pulverized, and to settle what that form should be, shall be our present endeavour.

(2389.) On clay loam in good heart it is possible that some of the turnip land that had been ridged up for spring-wheat had been, from some cause, prevented from being sown with that grain, and, of course, it must be sown with barley. The land had likely been gathered up from the flat, as in fig. 133, or it may have been cast, as in fig. 135; in either case the barley-land will be desired to be seed-furrowed in the same manner, that the ridging of the whole field may be uniform. Since the furrow for the spring-wheat was the seed-furrow, and its ridges had been formed with a view to make the surface of the field uniform from side to side, it will be impossible to re-plough those ridges with one furrow of the *common* plough, without disturbing their form. Such ridges must either be ploughed *twice* with the common plough, to bring them

back to their present form, for which repetition of work there may not be sufficient leisure, or they may be stirred with the grubber, a class of instruments with the importance of which you will be made acquainted below by Mr Slight, or ribbed with the small plough, fig. 370, without affecting their form. The choice of these various modes of stirring the ground may be taken according to circumstances. If the ridges have become much consolidated in consequence of being ploughed a considerable time, or of much rain having fallen, and if the soil itself be naturally firm, two furrows with the common plough will best put the land into a state for receiving barley; but should they be in a somewhat soft state, with perhaps rather too much moisture below, though with a kindly state of the surface, capable of affording a fine *tilth* with the harrows, then the grubber is the most proper implement for making a deep bed for the barley seed, while it at the same time retains the dry surface uppermost; and should the soil be naturally free while it is desired to retain the upper stratum of soil still uppermost, it may be ribbed with the small plough. Putting these ridges thus into the best state for the barley seed, there will be no difficulty with the remainder of the land. The first furrow given to barley land, which is at the same time in the best direction, is the *cross-furrow*, as in fig. 368, because being ploughed in an opposite direction to the seed-furrow to be afterwards given, the best means are taken to pulverize it. I need not here repeat what has already been said so fully on cross-ploughing in (2155.) to (2160.) inclusive. Although the land may not be all so cleared of turnips as to allow the cross-ploughing to extend from one side of the field to the other, it should be divided into two portions, one of which should be ploughed and sown while the other is clearing, and which may perhaps be cleared by the time the sowing of the first part is completed. After a passage of the harrows a double tine over the cross-ploughed land, the ridges should be feered and ploughed up for the seed-furrow, and the usual form of seed-furrow is either gathering from the flat, as shewn in fig. 133, or yoking two ridge-breadths together, as in fig. 135. Every plough should be employed in ridging up the seed-furrow for the barley-seed, for it is essential to the success of that crop that the seed be sown on the soil fresh turned-up, or on a *hot-furrow*, as it is termed. Both the cross-ploughing and seed-furrow should be *deep*. The former may be turned up with a broad stout furrow-slice, but the latter should be ploughed with a deep narrow furrow-slice, in order to pulverize the soil as much as possible, and to make the crests of the furrow-slices numerous and narrow, so as to disseminate the seed more equally when sown by hand; for the sowing of seed on a fine pul-

verized surface requires assistance of this sort, to cause it to be equally disseminated, inasmuch as on whatever spot every seed falls, there it lies, the soft earth having no elasticity like the firm furrow-slice of lea, and, hence, of all the sorts of grain, barley is the most likely to be *happer-ga'ed* in the sowing, and on that account every handful requires to be cast with greater force than other sorts of grain. The walking on soft ground in sowing barley is attended with considerable fatigue, and as short steps are most suited for walking on soft ground, so small handfuls are best for grasping plump slippery barley. Barley may be sown any time that is proper for spring-wheat, and it may be sown as late as the end of May; but the earlier it can be sown, the better will the crop be in quality and uniformity, though the straw will be less. The average quantity of seed sown broadcast, is 3 bushels to the imperial acre; when sown early less will suffice, and when late, more; because the later it is sown, there is less time for so quick a growing grain as barley to tiller and cover the ground. Mr Brown has some judicious remarks on this subject:—"Amongst the farmers," he says, "it seems a disputed point whether the practice of giving so small a quantity of seed (3 bushels per acre) to the best lands, is advantageous. That there is a saving of grain, there can be no doubt; and that the bulk may be as great as if more seed had been sown, there can be as little question. Little argument, however, is necessary to prove, that thin sowing of barley must be attended with considerable disadvantage; for, if the early part of the season be dry, the plants will not only be stinted in their growth, but will not send out offsets; and if rain afterwards falls, an occurrence that must take place some time during the summer, often at a late period of it, the plants *then begin to stool,* and send out a number of young shoots. These young shoots, unless under very favourable circumstances, cannot be expected to arrive at maturity; or if their ripening is waited for, there will be great risk of losing the early part of the crop,—a circumstance that frequently happens. In almost every instance an unequal sample is produced, and the grain is for the most part of inferior quality. By good judges, it is thought preferable to sow a quantity of seed sufficient to insure a full crop without depending on its sending out offsets. Indeed, when that is done, few offsets are produced, the crop grows and ripens equally, and the grain is uniformly good."* There is no grain so easily affected by weather at seed-time as barley, a dash of rain on strong land will cause the crop to be thin, many of the seeds not seemingly germinating at all, whilst others

* Brown on Rural Affairs, vol. ii. p. 45.

burst and cannot germinate; and in moist warm weather the germination is certain and very rapid. Indeed, it has been observed, that unless barley germinate quickly the crop will always be thin. I have seen the germ of barley penetrate the ground only 36 hours after I had sown it myself, and when it took place, the ground was smoking by the evaporation of moisture, caused by a hot sun in a calm atmosphere. I have also traced the germ of barley to the depth of 9 inches below the surface. The harrowing which barley-land receives after being sown is less than oat-land, a double tine being given in breaking in the seed, and a double tine across immediately after. Then the grass-seeds are sown with the grass-seed sowing-machine, formerly described in (2217.); the land is harrowed a single tine with the light grass-seed harrows (2218.); water-furrowed (2221.); and finished by immediate rolling (2220.). On strong soil, apt to encrust on the surface with drought, after rain the rolling *precedes the sowing of the grass-seeds*, and the process is finished with the light grass-seed-harrows; but on all kindly soils the other plan is best for keeping out drought, and giving a smoother surface for harvest-work. The head-ridges are ploughed and sown by themselves. Barley may be sown with the broadcast-machine as well as oats, and it is admirably suited for sowing with the drill-sowing-machine (2363.), which deposites the seed at a uniform depth and breadth between the rows, with about 2 bushels of seed to the acre, and such an arrangement affords opportunity for the exercise of the draw-hoe, to remove the wild mustard, which is apt to spring up amongst the spring crops in the vicinity of large towns, where street-manure is used to a large extent.

(2390.) Barley is sown after potatoes and beans, but never when the weather will permit the sowing of wheat. When intended for barley, the land is gathered up for the winter, water-furrowed, and gaw-cut, to prevent water standing upon it; and in spring it is cross-ploughed and ridged up with the seed-furrow. Barley is sown also at times after wheat or oats, and the sample in such a case is always fine coloured, but the practice is bad farming, and should never be pursued. It is never sown in Scotland after lea, but might be after the land had received a partial fallowing in spring. When sown in autumn, it does not stand the winter well in Scotland, though it does in England. Winter barley is always early ripe, but is seldom a prolific crop, and when it tillers late in spring to cover in the ground, the produce is apt to contain a large proportion of light grain. As an instance of late sowing of barley, I may relate what has fallen under my own observation. The late Mr Guthrie of Craigie, near Dundee, had early ploughed the greater part

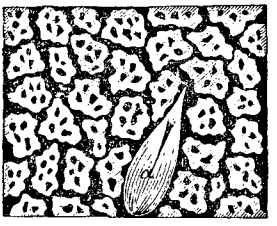
of a field of strong soil after turnips, and much rain had afterwards consolidated it. Being desirous of giving the land another furrow before sowing it with barley, he found the plough bring up large waxy clods, unfit to form a seed-bed for barley. He consulted me, and I advised him to rib the land with the small plough, fig. 370, instead of ploughing it. His men never having seen land so ribbed, I showed them the way, and saw the ground sown and harrowed with one double tine along. The sowing took place on 26th May 1819, and the ribbed land produced 12 bushels the Scotch acre more than that which was ploughed with the common plough, because all the tender part of the land had been kept uppermost.

(2391.) Now that you have seen the termination of the sowing season of the various sorts of grain usually cultivated on a farm, it may prove useful to you to give you an idea of the principles of the germination of seeds, and which you will find given here in the words of Dr Madden. [The process of germination consists chiefly of various chemical changes in the composition of the seed, by which its substance is rendered soluble, and in this state furnishes nourishment for the young plant. This change is effected by means of a highly azotised principle present in all seeds, and which, under the joint influence of *air*, *moisture*, and a *certain temperature*, undergoes various chemical changes, during the occurrence of which it is capable of exciting similar changes in other substances with which it may be in contact. Seeds are for the most part composed of starch, gum, sugar, albumen, and various saline matters; of these the starch is in general the most abundant, and the most important change produced during germination is the conversion of this starch into sugar. I have stated that the necessary conditions for effecting this change are, independently of the vitality of the seed itself, *air*, *moisture*, and a *certain temperature*; these three points are sufficient to regulate all the practical details of the sowing of seed, both as regards the weather, and the condition of the soil in respect of water and tillage.* If the season, for example, be not far enough advanced, then germination is either retarded by the lowness of the temperature, or the vitality of the seed is altogether destroyed by the continuance of hard frost. If, again, the soil be too wet, the seed does not obtain a sufficient supply of air, owing to the interstitial canals already mentioned, (1104.) to (1106.), being filled with water. To give you a better idea of this condition, you will perceive, in fig. 402, that the seed *a* is not supplied with any air beyond what reaches it in the state of solution in water. Again, if the soil be not properly pulverized, it is very possible that the seed may be badly situated for the purposes of germination, owing to the obliteration of the interstitial canals by pressure, as is shewn in fig. 403, where *b* represents a clod of earth, and *c* a stone, between which the seed *a* is placed. I need scarcely mention the remaining cause of imperfect germination. viz. the absence of moisture, as represented in fig. 404, where *a* is the seed, as this is far too rare an occurrence, under ordinary circumstances, to require notice. Lastly, the proper condition of soil for germination is, as

* See a paper by me on this subject in the Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 614.

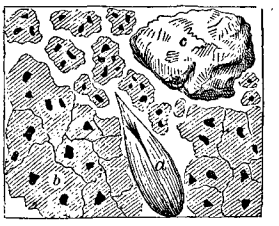
before noticed (1105.), where the pores of each particle are filled with water, while the interstitial canals are filled with air. This condition is shewn in fig.

Fig. 402.



SOIL WITH WATER AND WITHOUT AIR.

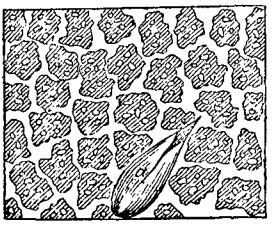
Fig. 403.



CLODDY AND STONY SOIL.

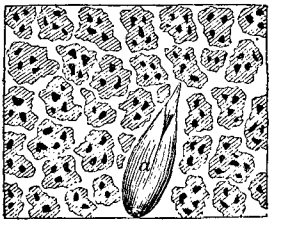
405, and it will at once be observed, that while the seed *a* obtains moisture by contact with the dark saturated particles of soil, it receives a continuous supply

Fig. 404.



SOIL WITH AIR AND WITHOUT WATER.

Fig. 405.



SOIL WITH WATER AND AIR.

of fresh air from that circulating constantly through the interstitial canals. "Lest any one should suppose that the contents of these interstitial canals must be so minute that their whole amount can be of little consequence, we may here notice the fact, that in moderately well pulverised soil they amount to no less than $\frac{1}{4}$ of the whole bulk of the soil itself. For example, 100 cubic of *moist* soil, that is, of soil in which the pores are filled with water while the canals are filled with air, as fig. 404, contain no less than 25 cubic inches of air. According to this calculation, in a field pulverised to the depth of 8 inches, a depth perfectly attainable on most soils by careful tillage, every imperial acre will retain beneath its surface no less than 12,545,280 cubic inches of air. Taking into the calculation the weight of soil, we shall find that every additional inch you reduce to powder by ploughing, you call into activity 235$\frac{1}{2}$ tons of soil, and render it capable of retaining beneath its surface 1,568,160 additional cubic inches of air.—H. R. M.]

(2392.) The subject of the condition in which seed is usually found deposited in the ground may be pursued a little farther, from the paper alluded to by Dr Madden, and the first conditions that strike one are bad ploughing and bad sowing. In fig. 406, the furrow-slices under *a*, *b*, and *c*, are all ill ploughed, as you may easily perceive; and the soil being so arranged, of course the seed will be irregularly deposited, as seen at *a*, *b*, and *c*, in fig. 407, where some are too deep, as under *b*, to germinate quickly, if at all, and others much nearer

the surface, as at *c*. In these various positions in which the seed is placed, it is obvious that the plants springing from them will appear and grow as irregularly, as seen in fig. 408, where the plants at *b* are much further advanced

Fig. 406.

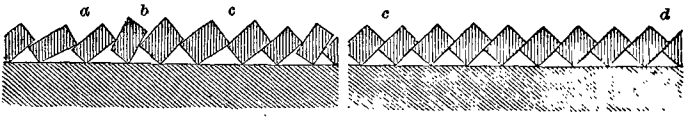


Fig. 407.

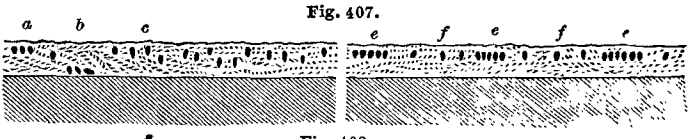
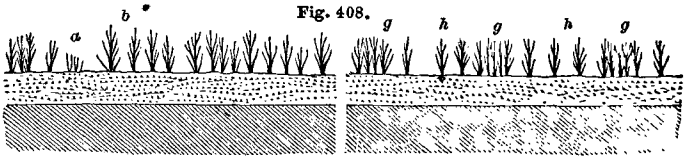


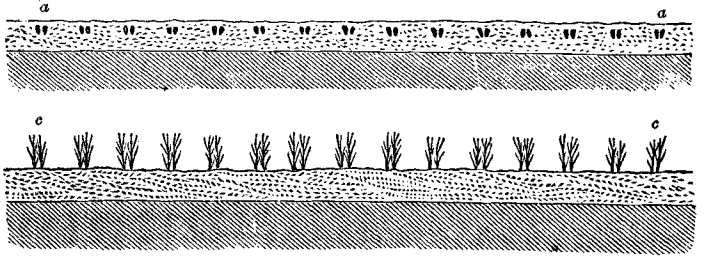
Fig. 408.



THE EFFECTS OF BAD PLOUGHING ON SEED. THE EFFECTS OF BAD SOWING ON SEED.

than those at *a*. In regard to bad sowing, although the furrow-slices are regular and well ploughed in the right-hand side of fig. 406, from *c* to *d*, yet the seed having been irregularly deposited on the surface, they have arranged themselves in one place too thick, as at *e e e*, fig. 407, and too thin, as at *f f*; and the consequences are very visible in the position of the plants in fig. 408, where they are too thick at *g g g*, and too thin at *h h*. Where such irregularities exist, and every farmer is liable to their consequences by the carelessness of their workpeople, it is clear that the crop cannot be uniform ; and it is a fact which cannot be disputed, however it may be explained, that the more uniform a crop is it is the greater, and affords better grain. If, on the other hand, you observe fig. 409, you will perceive that the seed has been deposited at uniform depths

Fig. 409.



THE GOOD EFFECTS OF THE EQUAL DEPOSITION OF SEED.

and intervals from *a* to *a*, and the consequence is, that the plants grow at uniform heights and strength as from *c* to *c*. Although this favourable result is obtained by drill-machines depositing every seed at a regular depth, which is

not the case of broadcast by hand, yet there are objections against sowing corn in *rows*, which all drill-machines do; but could they be made to deposite seed at a uniform depth, and at the same time disperse it broadcast, the objection would be disposed of. The objection to all crops placed in rows is, that the air having free access along the rows, while it encourages the growth of the cultivated, so also it does of wild plants, and to destroy the latter certain implements are used to stir the ground, while the former are, of course, allowed to grow; but as in their progressive growth the plants throw out innumerable root-fibres in every direction in search of food, the fibres which occupy the open space between the rows are destroyed in common with the weeds, and though no estimate can be formed of the amount of injury which plants sustain in the destruction of their root fibres, yet it is consonant to reason, that these fibres must be essential to the welfare of the plant, otherwise they would not be sent forth. It would therefore be worth while to ascertain by experiment, the comparative results derived from depositing seed broadcast at a uniform depth with ordinary broadcast, and with rows.

(2393.) I have amused myself at times in calculating the quantity of seeds of different grains sown in an acre, and on comparing the amount of crop actually received with what ought to have been their produce, and the deficiency which the results bear out appears incredible. Thus, Hunter's wheat gives 84 grains to 1 drachm weight; and taking it at 65 lb. per bushel, the number of grains in a bushel is 698,870, and giving 3 bushels per acre for seed, there will be sown on an imperial acre 2,095,510 grains, or 48 grains in the square foot. Now, I have counted ears of wheat to contain as high as 61, and as low as 24 grains each, the average thus being 44 grains; and allowing no more than 1 ear of produce from each grain sown, and allowing nothing for the tillering of the crop, the produce ought to be 44 fold; but the largest produce of wheat in the Carse of Gowrie is 52 bushels per imperial acre, or only 17 fold for the seed sown, what then becomes of the other 27 fold? Again, 80 grains of Chevalier barley, at 69 lb. per bushel, weighs 1 drachm, or affords 604,160 grains to the bushel, and, at 3 bushels to the acre, 1,812,480 grains per acre, or 41 grains to the square foot. Now barley yields from 32 to 21 grains in the ear, the average being 28, and allowing 1 ear from each grain sown, the produce should be 28 fold, but 60 bushels per acre is the best crop, or 20 fold of the seed, what then becomes of the 8 fold which is awanting? Once more. Potato oats give 134 grains to 1 drachm, at 47 lb. per bushel, or 806,144 grains to the bushel, and at 6 bushels an acre for seed, 4,836,864 grains per acre, or 111 grains per square foot. Now, potato oats differ in the yield of grains in the ear from 182 to 20, the average being 64, or 64 fold, allowing 1 ear from each grain sown, without tillering. Now 72 bushels is a good crop per acre, or 12 fold of the seed, what then becomes of the 52 fold awanting? These are incredible discrepancies, and how can they be accounted for? Can the attacks of insects and vermin, or the effects of soil and weather account for the loss? The subject is worth investigation, and were the result of investigation the discovery of means to protect the seed while it is in the ground, the produce would either be greatly increased, or the quantity of seed to be sown would require to be much lessened.*

* See some speculations of mine on this subject in vol. iv. p. 535 of Quarterly Journal of Agriculture.

56. OF TURNING DUNGHILLS AND COMPOSTS.

" The compost pile examine now and turn,
And, if 'tis not completely decomposed
Into one mass of vegetable mould,
With an unsparing hand throw in more lime.
When unremitting cold retards the stage
Of fermentation, heat, then, genial heat,
Must be applied.

GRAHAM.

(2394.) The ordinary mode of treating dunghills of farm-yard manure is very simple,—the principle upon which it is founded is quite consonant to reason,—and the results of the application of the manure so treated is also quite satisfactory. The treatment is, to spread every kind of straw used in litter, and every kind of dung derived from the various sorts of animals domiciled in the steading uniformly in layers, as it is supplied, over the area of the respective courts; to take this compound of straw and dung out of the courts at a proper period, and form it into a heap in the field where the manure derived from it shall be needed, with as much care as to mix the different ingredients of the heap together as they were in the courts, and to prevent the fermentation of the whole until the manure is used; and to turn this heap over in such a way, and at such a time, as the manure it contains shall be ready to be applied to the soil when wanted. The principle of this treatment is the simple one of commixing the various ingredients of straw and dung so intimately together, first in the courts, then in the dung-heap, when led out, and lastly in the same dung-heap when turned over to be duly fermented, as that the fermented manure shall be as uniform a compound as the nature of the materials of which it is composed will admit. And the result is, when the manure so treated is applied to the soil, it is found to be the most valuable of any known manure for every purpose of the farm. You have already been told how the courts should be littered, and been shewn the advantages of attending to this simple yet important part of rural management in (2023.) and (2024.). You have also seen how those courts are emptied of their contents, and the proper time when they should be so emptied, in (2025.) and (2026.) And you have witnessed how their contents are disposed of in heaps in the fields in which they shall be required, (2028.), and the reasons why they are formed in the manner recommended, (2029.). My present purpose is

to inform you how these heaps should be turned in order to bring them into the degree of fermentation best suited for making them into good manure; and the mode of actually applying that manure will be shewn to you when we come to consider the culture of the potato and turnip crops.

(2395.) Potatoes are the first crop which require a large quantity of farm dung. It is the practice of some farmers to drive the dung for potatoes direct out of the court, in its compressed state, and before it has been fermented at all. On strong soils, naturally unsuited to the growth of this plant, by reason of their heavy and tenacious character, long dung may be successfully used, because it assists to relieve the pressure of the soil upon the young plant. Indeed, on such soil, I have seen a drill of potatoes manured with dry twisted straw-ropes obtained from the coverings of the stacks in the stack-yard, and which was so manured for the purpose of ascertaining the difference, if any, betwixt it and the best made dung, produce as good potatoes as the dung. In like manner, potatoes may be raised well on soils of that character with horse-dung which has reached that state of worthlessness called *fire-fanged*. In all other sorts of soils the use of long-dung incurs imminent risk of a deficiency of crop, and therefore dung should generally be fermented for potatoes. Dung, when laid up in an uncompressed state in the court, as noticed in (2031.), becomes sufficiently fermented for potatoes, and may be driven out at once without farther preparation. There is one objection to the use of unfermented dung for potatoes, which seems to me insuperable, and it is, that where grains of every kind find their way among the litter of courts, and it is impossible to have the straw thrashed by the mill absolutely clean, or the seeds of weeds that may have been sifted out of the corn when cleaned, thrown upon the litter in the courts, though they ought to have been thrown away elsewhere; so long as these grains and seeds possess all their vitality, and that will escape destruction in unfermented dung, they will spring up amongst the potatoes, not in the intervals between the drills, where they might be removed by the horse-hoes in the process of cleaning the land, but actually amongst the potato-plants, having vegetated and grown along with them, and deriving as much nourishment from the dung as the potatoes themselves. I have frequently seen such an intermixture with potato-plants at various places, and very dirty and slovenly farming it makes. Having a piece of ground trenched from an old plantation, and being comparatively pretty clean, I was desirous of trying potatoes upon it for the first crop, and having no dung ready prepared for this extra space of ground, what was required was taken out of the court in which the corn-barn was situated,

and the result was as I have just described. No doubt, the weeds thus sprung up amongst the potatoes can be removed by the field-workers with the draw-hoe, when they are cleaning the crop, but the labour of removing large plants from that position, and especially when forced in growth by powerful manure, is considerable, and the weeding cannot be accomplished but by removing a considerable portion of the useful soil around the young potato plant. It is clear that it is much better farming to have no plants in this position to take away, than to have to remove them.

(2396.) On commencing the *turning* of a dunghill, it should be considered from which end it will be most convenient to take the dung and lay it on the land. On the supposition that the dunghill occupies the position explained in (2022.), the end from which the dung will be carted away will be the head-ridge. After determining this point, the next subject for consideration is, whether the dunghill will be once or twice turned before it is applied, and this point is determined by the crop for which the dunghill is preparing,—if for potatoes, only one turning is requisite, and two for turnips. As the first dunghill is intended for potatoes, it receives one turning, and it should be begun to be turned at the end farthest from the head-ridge. The unturned dung-heap slopes at both ends, as observed in (2028.), but the turned dunghill should be made of the same height throughout. To attain this end, the space occupied by the workers at the commencement, between the turned dung and the dung-heap, should be wider than at the middle of the heap, and the dung should be thrown to a greater height than the side from which it is taken. The usual width marked off on the dung-heap is 3 feet, which affords sufficient room for people to work in; but the first few spaces upon which the first divisions of the heap are laid, should be held narrower than 3 feet, until the desired height of the turned dunghill is attained at the end. The effect of this arrangement is, as the turning approaches the middle of the dung-heap, where it is of the greatest height, the space upon which the dung is *turned upon* will be more than 3 feet in width, and the additional width will be required near and at the middle, that the extra height of the dung-heap there may be reduced to the level of the end. After the middle has been passed, the spaces turned upon should be gradually lessened in width towards the end at which the turning is finished, where, as at the commencement, the turned dung will have to be thrown to a greater height than the dung-heap, to attain the medium height of the finished dunghill. There is much more of nice management in following these particulars of turning a dunghill than at first sight may appear necessary.

because the turned dunghill will not ferment equally throughout if it is of different heights. The greatest heat will be at the deepest part, where the dung will become comparatively short and compact, whilst at the shallowest parts it will continue crude and unprepared; and these different states of manure have very different effects on the soil. In ordinary practice, miscalculations are always made as to the uniform height of dunghills, for they are lower at the ends than in the middle; and if an endeavour is afterwards made to equalize the height, it is done by throwing the high dung of the middle towards the ends, and the effect of this expedient is, that no union takes place between the dung which was turned over in the regular way with what is afterwards thrown upon it; they ever after remain in different states, and rise differently to the graip when removed into the cart; and the middle part, besides, becomes trampled down and harder than the ends.

(2397.) Laying these down as the rules by which dunghills should be turned, the mechanical part of the operation is done in the following manner:—The people required to do this work are a man and a few field-workers, according to the size of the dunghills; and of this latter class, women are by far the best hands at turning a dunghill, because, each taking a smaller quantity of dung at a time upon a smaller graip than fig. 257, the dung is much more intimately mixed together than when men are occupied at this work, for they take large graipfuls, and merely lift them from one side of the trench they are working in to the other, without shaking each graipful loose, or scattering it to pieces. Turning dung is not a cleanly work for women, their petticoats being apt to be soiled in the trench by the dung on both sides; but there is a plan which the Berwickshire women adopt of keeping the bottom of their dress clean, which is to tie the bottom of the petticoat with the garters just below the knee, as long as they are at work. The man's duty is to cut the dung-heap into divisions of 3 feet wide across its breadth with the dung-spade, fig. 364, in the manner described in (2030.). When the edge of the dung-spade becomes dull, it is sharpened with a scythe-stone. The drier portions of the dung are put into the interior of the dunghill, and, when different sorts of dung are met with, they are intermingled in small graipfuls as intimately as possible. Each division of the dung-heap is cut down and turned over to the ground before another one is entered on, and, when the ground is reached, the scattered straws, and earth that has been damped by any exudation from the dung-heap, are shovelled up either with the broad-mouthed shovel, fig. 149, or the frying-pan shovel, fig. 176, and thrown into the interior. When straw-ropes are met with, they should be cut into small

pieces and scattered amongst the dampest portions of the dung. Though the dung-heap is cut into parallel trenches, the dung from the top of one trench is not thrown into the bottom of the former, but rather thrown upon the breast of the turned dung, so as the turned dung may slope away from the work-people. The utility of this form is, that when the dung is carting away it rises freely with the graip. When a dung-heap is thus turned over, and its form preserved as it should be, it constitutes a parallelopipedon, and is a well-finished piece of work.

(2398.) Unless much rain has fallen from the time the dung was led out of the court until the heap is turned, the dung will not be very moist, and not at all wet, but in a free workable state, with a slight degree of heat in it, and evaporation would be observable from it, were the air cold when it was turning. Very little moisture will be observed as having come from the heap. After this turning over, shaking up, and mixing together, which should be finished in the same heap as quickly as possible, that the whole mass may have the same time to ferment, the operation being performed about a fortnight before the time of planting potatoes, in the latter end of April and beginning of May, the ordinary temperature of the atmosphere is then such as a considerable degree of heat may be expected to shew itself in the dung in the course of a few days. There is no danger of this first fermentation proceeding to a great degree of heat, as the air is still cool at nights, and the largest proportion of the heaps consists of the dung of cattle, which is slow of fermentation at all times, and particularly in the early part of the season. The first external symptom that fermentation is proceeding in the heap is subsidence of its bulk, which, in the course of a fortnight, may contract 1 foot of height. A perceptible smell will then arise from the dung, accompanied with a flickering of the air over it, which is occasioned by the escape of vapour and some of the gases, but chiefly, I apprehend, aqueous vapour. By inserting a walking-stick into the heap here and there, a heat considerably more than that of the hand will be felt, and by pushing this stick into different parts of the dunghill, the relative heat of those parts will be ascertained, and the greatest heat may be expected to be felt at the side opposite from whence the wind blows, if there be wind, or even a breeze. The substance of the dunghill becomes more consolidated in consequence of the fermentation, and also more uniform; and a black coloured liquid will be found in some degree to ooze from its sides. If the soil upon which the dunghill stands was soft when the dunghill was formed, the oozing will then be absorbed by it, and exhibit no wetness of surface; but if the soil be firm, then the moisture will remain on the surface, and form small pools in

the ruts of the cart-wheels or open furrows. All the leakage, even if collected in one pool, would afford but a trifling quantity, indeed much moisture cannot exude from a dung-heap derived from courts in which the cattle are duly supplied with abundance of litter to keep them both dry and warm. So much for the *potato*-dunghill.

(2399.) As to the *turnip*-dunghill, it receives a somewhat different treatment, but still conformable to the purpose for which it is destined. It is turned twice, and on this account it is begun to be turned at the opposite end from that for potatoes; but the same rules are followed in doing it, as just described for the potato dunghill, and it also allowed to ferment for about a fortnight. At the second turning, which is given about a fortnight or ten days before the dung is used, the operation is commenced at the end at which the former turning terminated, and it is much more easily performed than the first, inasmuch as the substance is easier cut with the dung-spade, more free to separate and shake with the graip, and less care required to retain the rectangular figure formerly given to the dunghill. The weather at the second turning will be warm, and the fermentation, of course, rapid, so that apprehension may be excited that it will proceed to an injurious extent for the materials composing the dunghill. For raising turnips, however, there is little dread of the fermentation proceeding too far, as it is matter of experience that the more effete the dung is, the more valuable it is for the nourishment of the turnip plant, as is well known to every turnip farmer. When in this valuable state heat has almost entirely left it, it has become like soft soap, and rises in lumps with the graip, and would almost cut into pieces with the shovel. It is, moreover, sappy, cohesive, greasy, heavy, and of a dark-brownish black colour. The larger the mass in which dung in this state is found, the more valuable it is for turnips. To check rapid fermentation, a spitful of earth around the dunghill thrown upon its top, will have that effect to a certain degree. It is supposed by many farmers who grow Swedish turnips to a large extent, that dung of the same year cannot be transformed into this state in time for Swedish turnips, which ought to be sown before the middle of May; and in the temperature of ordinary seasons in Scotland at that time, the observation, I daresay, is correct. To obviate the want of so valuable an ingredient as old muck, it is the practice of some farmers to keep dung on purpose over the year. This would, no doubt, be a difficult matter on farms which depend entirely on their own produce for the manure applied on them; but let the sacrifice be made for one year either to collect farm-yard dung from external sources, and form it into a dung-hill for the succeeding year, or purchase other manure to a large

extent for one year, to raise a crop of turnips, and reserve the farm-yard dung for the Swedish turnips of the next year, and the object is gained. I have known many farmers attain this object to a partial extent, but no one whom I have observed practise it to so great an extent as Mr Smith, when he was at Grindon in North Durham, where he possessed the fine stock of short-horns that was admired by all who saw them. The dung of the year was made fit for white turnips, which were not sown for a month or so after the Swedes, and when both heat and time combine to bring it to a proper state for use.

(2400.) The subject of *composts*, when followed out in all its bearings, is an extensive one,—for there is not a single article of refuse on a farm, but what may form an ingredient of a compost, and be converted into a manure fit for one or more of the cultivated crops. At the same time there is great labour attending the formation of composts of every kind, as the materials cannot be collected together without horse-labour; and in summer, when those materials are most abundant, the labours of the field are most important, and to devote then the time required to collect them, would be to sacrifice part of the time that should be occupied in indispensable field-labour. I believe the most economical mode of forming composts, is to collect materials at times when leisure offers for the purpose; and when they have accumulated in sufficient quantity in the space allotted for their use, they can be put together by the field-workers when not necessarily engaged in the field. This advice will not suit the temper of those who, wishing to obtain their object at once, would make the forming of composts, or any other thing they have in hand at the time, the principal business of the farm; but you should be very cautious in determining to execute any piece of work that diverts horse-labour from its legitimate pursuits. I speak on this subject in this manner, from direct experience, for I was once strongly impressed with the benefits to be derived from using composts; and having plenty of materials at my command for making what I conceived should be good manure for the land, I persuaded myself, that manure to any extent might be made on the farm. Having access to an unlimited quantity of rough bog-turf and peat, large quantities of dry leaves in autumn, black mould to some extent, and those usual refuse products of the farm—quicken and potato haulms, with plenty of shell marl and a stratum of fine clay associated with it, and, of course, lime-shells from the market-town at all times, I was in these circumstances perhaps fully more favourably situated for making composts than most farmers. But little did I anticipate the labour I undertook. Two years convinced me that it was no child's play to collect together

643

bog-turf, marl, lime, dry leaves, and rubbish into one focus, and cart them all out again to the field or fields destined to receive the benefits of their composition. I put together the materials in the best manner I could devise or hear of, turned them at proper times with the greatest care, and certainly enjoyed the satisfaction of making a great deal of stuff apparently well adapted for the purpose intended; and in regard to its quality, I invariably found that the oldest made compost looked richest, most uniform in its texture, and most active in its effects, like old rotten muck; but notwithstanding these favourable appearances, unless very large quantities were applied, little benefit was derived from them; and even from 40 to 50 cart-loads to the imperial acre did not produce the good effects of 12 cart-loads of good muck. I could have managed the manual part of the work to any extent, for hired labourers could have been found to do it by piece-work, and the bog-turf was obtained on that condition; but the horse-labour was overpowering, for every acre thus required a cartage of 80 to 100 loads to provide no more than sufficient manure for it. An extra pair of horses could not have overtaken the additional labour thus imposed on the horses, and to incur that expense continually for the problematical good to be derived from the largest source of materials I possessed, namely, grassy bog-turf and peat-turf, was more than the most sanguine farmer is warranted in risking.

(2401.) It may, perhaps, prove interesting, to relate a few of the composts I made with those materials. 1. The first was a compound of peat-turf and lime-shells. The turf was wheeled to the margin of the bog on hard land, and allowed to lie some weeks, to drip the water out of it, and to make it lighter for cartage. The lime was mixed in the proportion of 1 cart of lime to 27 of turf. After the compound was twice turned, the mass became a fine greasy pulp in the course of a few weeks in spring and the early part of summer, so greasy that no one could walk on it without slipping. It was applied to good turnip land, to raise turnips, and the rule adopted to determine the quantity requisite for an acre was, in the first place, to fill the drills with it, and the quantity required to do this was from 30 to 40 double cart-loads per acre. The crop of white turnips was only tolerable, and certainly not nearly equal to what was raised in the same field with 12 loads of farm-yard dung, while the field became troublesomely covered with the bog-thistle, as also the common field-thistle, and a few of the burr-thistle, the lime not having been in sufficient quantity to destroy the vitality of the thistle-seed contained in the turf, though the degree of heat created in the mass to reduce it to a pulp was considerable. 2. Another compost was made of peat-turf and farm-yard dung, with a sprinkling of lime, as directed by the late Lord

Meadowbank, in his celebrated treatise on that subject, and which you may consult.* The effect produced from this was better than the former compost, but still not equal to the usual quantity of dung. 3. A mixture of lime and black mould, on some head-ridges that had too much earth accumulated upon them, was only applied before the land was drilled up and dunged for turnips, to thicken the soil; and labour such as this is not thrown away. 4. I tried a compost of rape-cake and earth, the compound was not proportioned, but enough of the cake was sprinkled on while the earth was turning over, to bring a very brisk fermentation into the mass. After the heat had nearly subsided, it was applied for turnips, and with much success. I may mention, that no account was taken of the exact number of cart-loads per acre of this or any other of the composts that were applied, such particulars being seldom noted by farmers, who are chiefly guided by judgment in the quantity of manure which any crop should receive. 5. Shell-marl and bog-turf, when mixed, produced no heat, and of course was never reduced into a uniform mass, for without the agency of heat, it is impossible to make any compost homogeneous. 6. The bog-turf burnt in the form of kilns, produced ashes which varied much in their specific gravities; those of a white colour being light and ineffective as a manure, whilst the red colour were heavy, earthy in appearance, and well suited to raise turnips; but I was unable to distinguish beforehand which turf yielded the white and which the red ashes. The trouble attending the casting of the turf in the bog, wheeling it to the side, exposing it to the air to dry, and afterwards either burning it to ashes, or carting it away for compost, was much greater than the quantity of ashes obtained, or the quality of compost formed would remunerate. Two years' labour with this concoction of materials were sufficient to give me a distaste for the business, and at length I dropped it, and preferred going into the neighbouring towns to purchase street and stable and cow-house manure, and bone-dust. These never disappointed me, and the eating off of the turnips which they raised every year with sheep, soon put the soil in a fertile state. Notwithstanding this resolution, I made a point every year of making up a large compost heap of the quicken gathered from the fallow land, as it was preparing for the turnips,—of the potato haulms as they were harrowed together, —and of the dried leaves in autumn, which would otherwise have blown about the lawn and shrubberies,—and of any other refuse that could be collected together on the farm. These, with the assistance of

* Meadowbank's Directions for preparing Manure from Peat, p. 19-23, edition of 1842.

a little fresh horse dung, and such water as the liquid manure tank, which was situate in the compost court, afforded, a compost was formed every year, which assisted in extending the boundaries of the turnip crop; and if that portion of the crop was not always heavy, the greater or less proportion of the turnips eaten off by sheep, enabled it to produce its share of the succeeding corn crops and grass, while, at the same time, the soil was thickened by the mould reduced from the compost. 7. Any of the animals that fall by disease, when their carcasses are subdivided, and mixed in a large quantity of earth powdered with a little quick-lime, will make a compost far superior to any of the preceding vegetable materials, for raising turnips, especially Swedes. 8. The produce of privies, and pigeons' dung, as well as the dung of fowls from the hen-houses, form excellent ingredients for putting into the tank of liquid manure to melt, and afterwards to distribute it over a compost. 9. Of late years saw-dust, which was long considered a useless article, and which may be obtained in quantity on some farms where saw-mills are at work, is now rendered useful in compost by being mixed with farm-yard dung, fermented to a considerable degree of heat, and then subdued with water;* and it may also be mixed with $\frac{1}{10}$ of its proportion of lime and road scrapings, and turned and kept in compost for 3 years.† Such a compost has raised crops of turnips, as evidenced by Mr William Sim, Drummond, Inverness-shire, and Mr H. H. Drummond of Blair-Drummond, Perthshire. 10. Spent tanner's-bark, when laid down for a time on the road around the steading and trampled under foot and bruised by cart-wheels, and then formed into a compost with either dung or lime, and allowed to stand for a considerable time, might be rendered into good manure for turnips. Saw-dust and tanner's-bark, or refuse of the bark of fir-trees, will not bear the expense of a long carriage; but where a supply of them is near at hand, their decomposition, though occupying a long time to effect, is worth the trouble. 11. In the vicinity of villages where fish are cured and smoked for market, refuse of fish heads and guts, or liver and oil refuse, make an excellent compost with earth. Near Eyemouth and Burnmouth, on the Berwickshire coast, 30 barrels of fish refuse, with as much earth from the head-ridges as will completely cover the refuse, is sufficient dunging for an imperial acre. The barrel contains 30 gallons, and 4 barrels make a cart-load, which sell for 1s. 6d. per barrel. From 400 to 600 barrels may be obtained for each farm in the neighbourhood in the course of the

* Prize Essays of the Highland and Agricultural Society, vol. xiii. p. 529.

† Ibid., vol. xvi. p. 274.

season. 12. Whale-blubber when mixed with earth forms a good compost for turnips. As this is a most caustic substance in a fresh state, it should be compounded with a large proportion of earth, and turned over and kept for at least 3 years until the compost becomes inert. I have seen a blubber compost, 2 year old, applied as top-dressing on grass burn up every plant by the roots, but after it becomes apparently effete it raises excellent turnips. 13. I have heard of a compost being made of whin and broom cuttings and earth, 3 loads of earth to 1 of the cuttings being mixed together and watered for 2 or 3 days, and to remain untouched for 8 or 10 days more, when it is turned, and again allowed to rest for 10 days, when it is fit to be applied as manure. The cost of making this compost was estimated at 2s. per cart-load, and is said to have raised wheat and oats well. But the fish refuse which I noticed before is to be obtained at some places at 2s. a load, and there can be no comparison in the relative value of it and the cuttings. You thus see how endless is the subject of composts for manure; and it is obvious, from what has been said, that the kind of compost which you may make depends entirely on the nature of the materials which can be supplied in your immediate neighbourhood.

(2402.) So numerous are the articles which are now presented to the notice of the farmer in the name of manures, that but to notice each shortly would occupy many pages; nor is it incumbent on me to describe them at present, as the greatest number have yet to establish a character for themselves by repeated experiments in successive years. This will, no doubt, put some of them to too severe a trial; but it will be necessary, inasmuch as they may not be able in the second year to confirm the pretensions they assumed in the first. I remember of a compound which became celebrated some years ago after one year's trial, for the turnips raised with it were really good, and could have stood a comparison with those grown by the best muck of the farm; but, alas, in the second year even, the substance was almost a complete failure, not that the original composition would have failed in the second any more than it did in the first year, but the demand for it in the second year had probably increased so much in consequence of the success attending its use in the first, that the manufacturer, to supply the market with the desired *quantity*, had taken the liberty to injure its quality; and the consequence to him was exactly what he himself might have anticipated, the farmer lost faith in the manure and distrusted the manufacturer. I was induced by a flaming advertisement which appeared constantly in the papers at the time, to try a compound manure; but in this substance I was only once deceived,—"once and for aye," for in

truth it had no better effect in raising turnips, for which it was specially recommended, than black mould which was tried alongside of it. Such results as these should induce caution in the use of compounded manures, the composition of which is unknown to you; still it is right to try them, as some one may turn out to be a really valuable substance, but the trials should be made at first on a small scale, if you are amongst the first to try it; but if you hear of others having succeeded, then, of course, your confidence may be yielded to it with the greater safety. To make known whether any new substance has succeeded or not, I think it is incumbent on every farmer to do so for the sake of his brother farmers, and there are now many publications which devote themselves to the promulgation of rural practice. But I have been of opinion for many years that no farmer should purchase any compounded substance advertised as a manure, unless it happens to be a natural substance, for, even in the hands of honest men, compounds may fail to continue to afford the satisfaction they once did, as carelessness in compounding an article that is much in demand, and of which large quantities are made at a time, is a very natural, and not an uncommon consequence. Besides failure in a case of this kind is a very serious matter to the farmer. It is not merely the value of the article itself which constitutes his entire loss, though even that may be considerable, but the consequence to future years. The crop immediately dependent on the manure is not only deficient, but the *the remaining part of the deficient crop is always of inferior quality.* This is an invariable effect in every crop; and its converse being equally true, that a full crop is always one of fine quality, and not only this, but every crop in the course of the rotation is affected by the state of the one which directly receives the manure, that is, if the fallow crop, as the turnip crop is called, be deficient and of inferior quality, the succeeding ones will not exhibit that vigour of growth by which a full fallow crop is invariably succeeded. I do not pretend to explain the cause of this result, nor have I ever seen it attempted to be explained, but as a *fact*, it is indisputable, and I have heard the fact noticed by many farmers. You thus see how very much it is for your interest to be assured of the efficacy of every manure that you are to apply. To be assured of their efficacy, it has been recommended to analyze every manure before it is applied, in order to ascertain whether it is really the article it is given out for. As an instance of the necessity for such analysis, I will quote a case or two adduced by Dr Madden. He says, " Three different specimens of nitrate of soda were submitted to analysis, when they were found to contain respectively 14, 25, and

26 per cent. of common salt. Now these specimens were purchased from extensive dealers in the article, and were contained in the bags in which it was imported, so that we have no reason for suspecting the honesty of the retailer; and it follows, therefore, that this shameful amount of adulteration must be effected prior to its being shipped for Britain. I would desire that you bear in mind, however, the fact, that the presence of common salt, even to this enormous extent, may be natural, but yet the imposition upon the British farmer is equally glaring, whichever be the case, as will be seen by the following statement regarding saltpetre. This article, likewise, contains common salt, though in much smaller quantities; but in this instance, the fact is not attempted to be concealed. Every cargo is analyzed at the India House before it is sold, and the per centage of salt marked upon it, and the amount of salt is deducted from the lot purchased. For example, suppose the saltpetre contained 10 per cent. of salt, if the purchaser buys 100 cwt., he receives the 100, but only pays for 90. Hence, therefore, there is no deception; but we would ask, how it happens that the same is not done with the nitrate of soda, and that those specimens, containing from 14 to 26 per cent. of salt, should all be sold at one and the same price? Why, if justice were done in this case, the specimen containing 26 per cent. should have sold at 22s. in place of 25s., if that be the fair price for the lot containing 14 per cent.; and if, on the contrary, 25s. is the proper price for the pure article, these three lots should have sold respectively at 21s. 6d., 18s. 9d., and 18s. 6d. per cwt." I may here mention, casually, in regard to the presence of salt in both the saltpetre and nitrate of soda, that it must be natural, and not placed there by human agents; for common salt in the countries from whence these articles are imported, is much higher priced than the articles themselves. Strictly in connection with the purity of manures is the price demanded for them of the farmer. If other articles are charged in the same proportion as saltpetre is, as is shewn by the following statement of Dr Madden, the profits of the manure-dealer must be much greater than those of the farmer, even after all the risk he runs in using manures unknown to him. "Before leaving this interesting subject," continues Dr Madden, "I would make one other observation, viz. concerning saltpetre. I find, by reference to the most extensive purchasers of this article, that it sells at the India House in 5 ton lots at a price varying from 25s. to 29s. per cwt.; whereas it is retailed to farmers at the enormous charge of from 50s. to 55s. For example, I analyzed a specimen sold to a farmer at 55s. per cwt., and detected 2 per cent. of salt in it; whereas, another specimen, purchased at the India House at

28s. 6d. per cwt., contained less than 1½ per cent. of salt, and be it remembered, the lots were purchased at nearly the same time, during which there had been little or no fluctuation in the market." In a note, Dr Madden mentions the practice of an extensive dealer in nitrate of soda in England, that he examines whatever he buys, and finds the average amount of salt to be from 8 to 10 per cent., and that he rejects as "*useless stuff*" any lot containing above 13 per cent.* The purity of so simple a substance as saltpetre or nitrate of soda can at once be ascertained by analysis, but the case is rather different with many of the compounds at present offered to the acceptance of farmers; their analysis can hardly prove so satisfactory. If experiments are to be made with substances extraneous to the farm, I think that chemist would act most judiciously who would suggest a mixture of a few of those simple substances which he conceives would benefit any particular crop, or the whole series of crops usual through a rotation, rather than any compound, however high sounding. A farmer can at once see what he is about when he himself forms a compound of various simple substances, differently proportioned, as suggested to him by an intelligent chemist. He can purchase each of these in as pure a state as they usually are made by practical chemists, who make them on a large scale. He himself does not know what may be the result of their application, he only expects results such as he is led to expect from the information given him by the chemist; but, working as he does, even in the dark, when he works under the guidance of a scientific man, who has no interest in the materials he recommends, he has confidence in what he is about to undertake, because he considers himself as his own agent in the business, purchasing simple ingredients, the nature of which is known to every one, and the commixing of which has been performed under his own eye. Far different is the case when he employs an article the purity or impurity, the efficacy or inefficacy, of which is equally unknown to him, and in the application of which he cannot anticipate a single result. Till some such plan is established for the use of extraneous manures, their results will be determined by mere chance, and the confidence of the farmer in them will fluctuate every year as the result turns out favourably or otherwise, till at length the use of them will be abandoned with contempt. All *natural* substances used as manure, such as bones, gypsum, guano, nitrate of soda, &c., are not the objects of the foregoing remarks; but should it be objected that the substance of the compound manures, being themselves natural com-

* Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 575.

pounds, cannot be sold as simple substances, it may be answered, that all the natural compounds which they contain, by being rendered dry or concentrated, could be sold as natural compounds, which may perhaps become equally valuable as others; but as long as they are mixed up with other matter, no one can say whether the valuable or valueless materials in them predominate.

(2403.) A simple list of the various ingredients at present in the market for the use of farmers will puzzle you as to the choice you should make amongst them. The names and prices are taken from the Mark-Lane Express of 24th April, and the New Farmers' Journal of 8th May 1843. They are as follows :—

Animalized black, L.3, 3s. to L.3, 5s. per ton at Dunbar.
Agricultural salt, 34s. per ton.
Chie-fou, 21s. per cwt.
Clarke's dessiccated compost, L.3 : 12 : 6 per hhd, sufficient for 3 acres.
Chloride lime, 28s. per cwt.
Daniell's new Bristol manure, 8s. per qr.
Graves, L.6, 10s. per ton.
Gypsum at the waterside, 32s. 6d. per ton; land and housed, 38s. to 42s. per ton according to quantity.
Grimwade's preparation for turnip-fly, 10s. 6d. per packet, sufficient for 3 acres.
Guano, 10s. to 14s. per cwt. according to quality.
Hunt's bone-dust, 18s. per qr.
Hunt's half-inch bone, 16s. per qr.
Hunt's artificial guano, L.8 per ton.
Hunt's new fertilizer, 13s. 4d. per qr.
Lance's carbon, 12s. per qr.
Lance's humus, 14s. per qr.
Liverpool Abbatoir Company's animalized manuring powder, L.2, 10s. per ton.
Muriate of ammonia, 24s. per cwt.
Muriate of lime, 12s. per cwt.
Nitrate of soda, 18s. to 18s. 6d. per cwt. duty paid.
Nitrate of potash (saltpetre) 26s. 6d. per cwt.
Owen's animalized carbon, 25s. per ton, free on board at Copenhagen.
Potter's artificial guano, 15s. per cwt.
Poittevin's patent disinfected manure, 13s. 6d. per qr.
Poittevin's highly concentrated manure, 30s. per qr.
Petre salt, 4s. per cwt.
Rape-dust, L.7 to L.8 per ton.
Rape-cake, L.6. 10s. to L.7 per ton.
Rags, L.4 to L.4. 10s. per ton.
Soda-ash, 14s. to 16s.
Sulphuric acid, 2½d. per lb.
Sulphur for destroying worms in turnips, 16s. per cwt.
Soap-ashes, 10s per ton.
Sulphate of soda, 7s. 6d. per cwt.
Sulphate of ammonia, 18s. per cwt. at Dundee.
Trimmer's compost for clover, wheat and turnips.
Urate of the London Manure Company, L.5 per ton.
Watson's granulated compost, 10s. per cwt.
Wolverhampton imperial compost (Alexander's), 12s. per qr., subject to carriage to London, or forwarded from Wolverhampton.
Willey dust, L.4. 4s. per ton.
Wright's alkalies, 28s. to 42s. per cwt.

The following are the weights per bushel of some of the substances enumerated above :—

	Per Bushel—lbs.	lbs.		Per Bushel—lbs.	lbs.
Agricultural salt, . .	75 to 80		Nitrate of soda, . .	80	
Alexander's compost, .	65		Petre salt, . . .	75	
Bone-dust, . . .	42 to 44		Rape-dust, . . .	56	
Clarke's dessiccated compost,	60 to 65		Saltpetre . . .	80	
Daniell's Bristol manure,	50		Soda-ash, . . .	60	
Guano, foreign, . .	56		Sulphate of ammonia, .	70	
——— Potter's . .	65		——— of soda . .	60	to 65
Gypsum, . . .	80 to 84		Trimmer's compost for clover,		
Hunt's new fertilizer, .	65		wheat, and turnips, .	60	to 65
Muriate of ammonia, .	65 to 70		Urate, ...	50	

(2404.) To reduce farm-yard dung to the saponaceous state recommended and described in (2399.), is contrary to the theory propounded by non-practical writers; and for the ordinary manuring of the farm, the recommendation, it may be acknowledged, is carried to an extreme; but for the purpose of raising a good crop of turnips, and especially of that invaluable kind the Swedish, it is beyond dispute that no manure, of whatever kind, is so congenial to their constitution as well made old muck. Until, therefore, a substitute is found for this ingredient, equal to it in efficacy, and as attainable, it will be made and applied by every farmer who is desirous of raising a good crop of Swedish turnips. The recorded opinions of Sir Humphry Davy on this subject, though oft referred to caution practical men against his conclusions, nevertheless deserve examination, because of the common sense-like manner in which he states his views, and on this account these should be the more explicitly refuted; and that they will one day be refuted I have no doubt, for I am persuaded that where practice and theory disagree, theory will be found to be in the wrong. In regard to the general principle of the action of vegetable manures, he says:—"There can be no doubt that the straw of different crops, immediately ploughed into the ground, affords nourishment to plants, but there is an objection to this method of using straw, from the difficulty of burying long straw, and from its rendering the husbandry foul." You observe at once, here, that the theory of the use of clean straw as a manure, is objected to solely on the score of a difficulty of using it in that state in practice. If *such* an objection may be valid against the use of straw, so may it be against the use of unfermented dung. If practice is to be respected in this instance, why not in the other? But Sir Humphry proceeds to render the straw more manageable when he says—"When straw is made to ferment, it becomes a more manageable manure; but there is likewise, on the whole, a great loss of nutritive matter. More manure is perhaps supplied for a rough crop; but the land is less improved than it would be, supposing the whole of the vegetable matter could be finely divided and mixed with the soil." Here the remark suggests itself, that if straw is allowed to be fermented because of its being more manageable in that state for practice, so might dung be allowed to be more fermented for the same reason. If deference is paid to practice in one case, why not in the other? To obviate the inconvenience of burying long straw, Sir Humphry recommends it to be chopped thus:—"It is usual to carry straw that can be employed for no other purpose to the dunghill to ferment and decompose; but it is worth experiment, whether it may not be more economically applied when chopped small by a proper machine, and kept dry till it is

ploughed in for the use of a crop. In this case, though it would decompose much more slowly, and produce less effect at first, yet its influence would be much more lasting." I have no doubt that chopped straw would raise potatoes on strong clay land, and when applied on summer fallow, a good crop of wheat would also be raised; but in all free soils, straw, in whatever state, whether long or chopped, would only keep the soil so open as to let in drought, retard vegetation, and it would be found lying at the bottom of the furrow in an inert state, as useless in short as *fire-fanged* straw. In regard to the fermentation of farm-yard dung, which is a composite manure, Sir Humphry admits the propriety of its undergoing a slight fermentation, as thus: "A slight fermentation is undoubtedly of use in a dunghill; for by *means of it* a disposition is brought on in the woody fibre to decay and dissolve, when it is carried to the land, or ploughed into the soil; and woody fibre *is always in great excess* in the refuse of the farm." So that fermentation in the dunghill is necessary to the dissolution of woody fibre, and as woody fibre is in great excess in the refuse of farms, it follows that fermentation ought to be generally allowed in dunghills, so that the question of fermentation here is only one of degree. "Too great a degree of fermentation is, however, very prejudicial to the composite manure in the dunghill; it is better that there should be no fermentation at all, before the manure is used, than that it should be carried too far. The *excess* of fermentation tends to the *destruction and dissipation of the most useful part of the manure;* and the ultimate results of this process are like those of combustion." If it is here meant to convey the idea that *fire-fanged* dung is fermentation to excess, the idea is correct, for I suppose no farmer thinks otherwise; but that the usual degree of fermentation allowed in dunghills renders the manure useless is inconsistent with experience. It is quite true, as Sir Humphry says, that "It is a common practice amongst farmers to suffer the farm-yard dung to ferment till the fibrous texture of the vegetable matter is entirely broken down, and till the manure becomes perfectly cold, and so soft as to be easily cut by the spade;" but so far from the most useful part of the manure being dissipated when the dung attains this state, experience assures us that the finest Swedish turnips cannot be raised with dung in a less elaborated state; and this conclusion is inevitable, that if the most valuable part of the manure *is* dissipated by the fermentation usually allowed in dunghills, that most valuable part is not required for raising the best crop of Swedish turnips, and that being the case, it is unnecessary to trouble ourselves to retain it. But what are the best parts of manure? "During the violent fermentation," says Sir Humphry, "which is necessary for reducing farm-yard manure to the state in which it is called *short muck*, not only a large quantity of fluid, but likewise of gaseous matter, is lost; so much so, that the dung is reduced one-half to two-thirds in weight; and the principal elastic matter disengaged is carbonic acid with some ammonia; and both these, if retained by the moisture in the soil, are capable of becoming an useful nourishment of plants." No doubt both the fluid and gaseous products of decomposing vegetables perform important functions in the economy of nature, but if they escape while dung is preparing in the best state for use, according to invariable experience, it follows as an inevitable consequence, that these products of fermentation are *not requisite, in conjunction with short muck*, to raise a crop of turnips. They may be useful ingredients for other purposes, and at other times, but it is

clear that the turnip crop can be raised to a better state without than with them. Why, therefore, attempt to retain their presence on the particular occasion?*

(2405.) Whether a more scientific mode of forming dunghills, in consonance with practice, will ever be discovered, I cannot pretend to say; but as there seems no bounds to the discovery of science in other arts, we should not limit its powers of application to the art of husbandry. Experiments are at this moment in progress on the very subject of the formation of farm-yard dunghills, in connection with which I may mention the distinguished name of Professor Henslow, of Cambridge, who, in a series of letters addressed to the farmers of Suffolk, and which have appeared in the public prints, suggests the propriety of their performing experiments to ascertain whether the ammonia which escapes in the gaseous state as a carbonate of ammonia may not be retained in dunghills by the instrumentality of gypsum? Should the event prove successful, we may perhaps expect to hear of important improvement in the management of ordinary dunghills. Till the experiments are tried, which time alone can do, I am happy in placing before you the opinion of so distinguished a philosopher as Professor Sprengel on the *value of old dung*, when he says in his valuable essay on manures, which ought speedily to appear in an English dress, that "The longer the dung is left in the dunghill, the more advantageous will be the preparation of the compost, because the ammonia, disengaged from the dung and urine in it, will become chemically combined with humic acid." It will be observed that these sentiments bear a strong analogy to the subject which engages the attention of Professor Henslow. As a satisfactory conclusion to the theoretical part of this subject, I give you the following explanation of the fermentation of manure, and its effects, by Dr Madden.—[Whenever dead organic matter, either animal or vegetable, is exposed to air in a *moist* state, it absorbs oxygen, which, by entering into combination with its carbon, destroys its original composition, and gives rise to the production of various new compounds, which in their turn suffer decomposition by means of fresh supplies of oxygen being absorbed, and so on in a continued series until the whole mass is reduced to chemical compounds of such stability as to resist the further action of oxygen under ordinary circumstances. During this series of changes the various solid compounds are converted first into fluid and then into gaseous products; which latter, by escaping into the air, become lost. Chemists are much divided as to what precise amount of decomposition is requisite to render organic matter in a proper state to become food for plants; all agree that decomposition must have *commenced*, some maintain that it must be *completed*. My own belief, founded on extensive observation and not a few experiments, is, that *all the products of decomposition, in every stage, are available as food for plants, provided they are either liquid or capable of dissolving in water*. These observations will, of course, regulate us in the management of the "midden." Whenever any moist organic matter absorbs oxygen, its chemical union with its carbon gives rise to an increase of temperature, which increase enables the surrounding portions to absorb oxygen more rapidly than they otherwise would do; these parts in their turn become heated, and thus the influence extends through the entire mass, the amount of heat being proportionable to the size of the mass, its degree of moisture, and quantity of air contained within its interstices. By careful management you can retard or accelerate the fermentation of your

* Davy's Agricultural Chemistry, p. 267-89, edition of 1839.

"midden" to almost any extent, from scarcely any change taking place, to so great a rapidity as to endanger the whole taking fire from the heat evolved. The most profitable way for dung to ferment is slowly but steadily, so that by the time it is required for use, it will readily cut with a spade like soft cheese, and exhibit a uniform rich brown colour, and emit no smoke unless the air be very frosty. During fermentation, the azote contained in the various constituents of the dunghill unites with hydrogen, and forms ammonia or hartshorn, which being very volatile, is apt to escape with the watery vapour and other gaseous products of decomposition. Various means have been of late recommended to prevent this, but none of them appear to me at all satisfactory, and I believe, have not as yet given very satisfactory results when applied to practice. The best condition for a "midden" to be in is, when it contains a sufficiency of water to cut moist, and yield a little liquid by pressure, but not enough to run from it spontaneously; this is easily effected by draining the "midden" stance, if in the court, so that all superfluous moisture runs off into the drains, which, of course, must lead to the liquid manure-tank, from which in dry weather it should be pumped up and scattered uniformly over the "midden;" in this state of moisture, scarcely a perceptible quantity of ammonia is lost, as it all remains in solution, and I believe that this plan will be found in all cases to be superior to every other hitherto devised for preserving farm-yard-dung.—H. R. M.]

---

57. OF PLANTING POTATOES.

"——— the potato plat
Should now be delved, and, with no sparing hand,
Manured; ———
The dibbling done, the dropping of the chips
Is left to little hands, well pleased to lend
Their feeble help: ———"

GRAHAM.

(2406.) The potato crop is cultivated on what is called the fallow-break or division of the farm, being considered in the light of a green or ameliorating crop for the soil. Following a crop of grain, whose stubble is bare in autumn, the soil is ploughed early in the season, that it may receive all the advantages which a winter's sky can confer it in rendering it tender; and as potatoes effect a dry and easy soil, the piece of land intended for them may be ploughed and even partially cleaned in spring. Time for *cleaning* is very limited in spring, and on this account the cleanest portion of the fallow-break should be chosen for the potatoes to occupy. The stubble will either have been cast, fig. 135, in autumn, or clove down without a gore-furrow, fig. 140, according as the soil is strong or free; and having been particularly pro-

vided with gaw-cuts, to keep the land as dry as possible all winter, for a crop which requires early culture in spring, as potatoes do, it is probable that the land thus appropriated will be able to be cross-ploughed, fig. 368, soon after the spring wheat and beans are sown, if either is cultivated on the farm, and if not, the cross-ploughing for potatoes constitutes the earliest spring work after the lea. After the cross-furrow, the land is thoroughly harrowed a double tine along the line of the furrow, and then a double tine across it, and any weeds that may have been brought to the surface by the harrowing are gathered off, along with any isolated stones that would appear unseemly on the surface. If the land is clean, it will be ready for drilling, if not, it should receive another ploughing in the line of the ridges, that is, across the cross-furrow, by being ridged up in casting, and then again harrowed a double tine along and across, and the weeds again gathered off. Should the surface be dry after the harrowing which succeeded the cross-ploughing, and the weather appear not likely to continue dry, the grubber will be a better implement to give a stirring to the soil than the plough, as it will still retain the dry surface uppermost, and it will also bring up to the surface any weeds that would entangle itself about the implement. The two-horse grubber is an excellent implement for stirring the soil when it has become somewhat solid by rain, or by lying untouched for a time. The time occupied in doing all this, as the weather will permit, may be about a month, that is, from the middle of March to the middle of April, when the potato crop should be actively preparing for planting. As the land cannot receive more ploughing in early spring than it should, to stir the land a little more, and make it still more tender, the drills first made for securing the manure of the potato crop should be set up in the double mode, as particularly described in (2177.) and (2178.).

(2407.) While the land is preparing, and it will not be possible to prepare it with continuous labour, as the oat-seed and the early part of the barley-seed will have to be attended to, the seed of the potato crop must also be attended to, and this is more especially the duty of the field-workers. The potato-pit is visited for the purpose, the thatch and earth are removed, the potatoes are taken into a barn where they are prepared into sets to be planted. The tubers are either planted whole, or cut into parts called *sets*. Whole potatoes create a great waste of seed, and when the sets are cut very small, the plants that arise from them are apt to be puny. The usual practice is to cut a middling-sized potato into 2 or 3 sets, according to the number of eyes it may contain, for unless there is at least one eye in every set, no plant will arise from it;

and it is even precarious to have only one eye in a set, in case some accident should overtake it, or it may have lost its vitality. The sets should be cut with a sharp knife, be pretty large in size, and chiefly taken from the rose or crown end of the tuber. When fresh, the tubers cut crisp, and exude a good deal of moisture, which, however, soon evaporates, and leaves the incised part of the set dry. A very common practice is to heap the cut sets in a corner of the barn until they are to be planted; and perhaps, if they had been exposed to drought prior to this treatment, they might remain there uninjured, but if they are heaped up immediately after they have been cut and while quite moist, the probability that those in the heart and near the bottom of the heap will ferment and evolve a considerable degree of heat, in which state it is doubtful that they will vegetate when planted, or at least that they will present so vigorous a plant as a non-heated set would originate. The safe plan, therefore, is to spread out the sets thinly on a floor, until they are fairly dried, when they may be put together somewhat thicker, but never on any account in heaps of 2 or 3 feet in height. I believe that much of the injudicious treatment which the sets of potatoes receive after they are prepared, arises from the inconvenience attending their occupation of the barn. The potatoes are put, in the first place, into a lock-up apartment, and to accommodate as many potatoes in any apartment as is required for seed to plant a few acres of land is what few farmers can do; still it is thought proper that an article which is desired by man and beast, should not be left at the mercy of every creature. The straw-barn cannot be appropriated to them, for the cattle-man and ploughman must have daily access to it. The corn-barn is usually occupied at this particular period with a part of the barley seed which had been thrashed in quantity, that time may not be spent at the mill which ought rather to be devoted to forward the labours of the field. The implement-house is but a small apartment, and contains many small articles that might be mislaid, were they taken out of their proper places. So the corn-barn and the boiling-house are the only places in which potatoes can be taken to undergo the preparation of being converted into sets for planting; but though there may be room to hold the whole potatoes, there may not necessarily be, and, indeed, there will not be, room for the sets to be spread out sufficiently thin, and so they are heaped together in the most convenient corner of either apartment, and to this circumstance, I believe, may be ascribed one of the causes at least which of late years rendered the potato sets so delicate in bearing the vicissitudes of the season. The sets required to plant an imperial acre of land will fill 36 bushels;

so, should there only be from 5 to 10 acres of potatoes raised on the farm, so large a bulk of seed, kept in the state in which it should be, will of course occupy a large apartment; and it is necessary that the whole sets be prepared before any of the planting is commenced, as there will not be time to devote to the tedious process of cutting sets when the operations of the field are in progress.

(2408.) The state of the potatoes, when taken out of the pit, will depend on the temperature of the weather in spring, and also on the state they were in when pitted in autumn. In cold weather, they will not be much sprouted in the pit by the time they should be planted; but should they have been heated at all, in consequence of the wet state in which they had been pitted, or the unripe state in which they had been taken up and pitted, they will be sprouted independently of the temperature of the external air. When the sprouts are long, they should be removed, as it will be impossible to preserve them entire; but if the quickening of the tubers be mere buds, these can be preserved, and they are of advantage, inasmuch as they will push above ground several days sooner than sets that are not sprouted at all. It should be kept in mind, however, that sets with long sprouts, and sprouted sets which have been long kept after being taken out of the pit until planted in the field, are apt to set up puny plants. In selecting tubers, therefore, to cut into sets, the middle sized that have not sprouted at all, or have merely pushed out buds, will be found the soundest; and wherever the least softness or rottenness is felt, the tubers should be entirely rejected, and even the firm portion of these should not be used as seed. The small potatoes should be picked out and put aside to boil for poultry and pigs. Those potatoes which are not required for seed, but are nevertheless firm and of good size, whether intended for sale or for use in the farm-house, should be placed in an outhouse, until disposed of or used, the apartment having, if possible, an earthen floor, and kept in the dark, though with access to the air, and water thrown upon the potatoes occasionally, to keep them crisp, but not at all moist, and turned carefully over by hand, when the sprouts are taken off.

(2409.) To insure the vitality of the sets in the ground, even when planted under adverse circumstances, it has been recommended to dust them with slaked lime immediately on the potatoes being cut, and the sap, on exuding from the incised part, will then be immediately absorbed by the lime, which, on forming a paste, encrusts itself on the incised surface.* Others recommend to dip the sets in a thick mixture of lime and

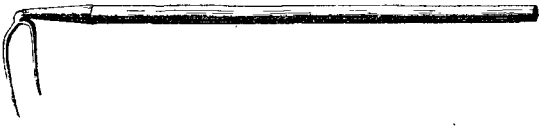
* Prize Essays of the Highland and Agricultural Society, vol. xiv. p. 144.

water, which, on drying, envelopes them in a coating of plaster. This latter plan would be attended with some trouble, and seems to offer no advantage over the former, which is easily done with a riddle as the sets are cut, and can do no harm at all events. It has also been recommended to sprout the sets prior to planting them, in order to test their vitality. The plan suggested is to spread the sets on the ground, in a part of the field they are to be planted, 2 or 3 inches thick, to cover them with a thin coating of earth, and then to water the earth frequently with a watering-pan, until they are all sprouted, taking care to have them sprouted by the time the land is manured to receive them. They are then to be carefully placed in baskets, and set in the ground with the sprouts uninjured. This process of sprouting is said to accelerate the vegetation of the sets in the drill at least 14 days. If potatoes that have sprouted in the pit are cut into sets and *immediately* planted, they should be in as favourable a state to grow in the drill as when subjected to this process; and however easily it may be conducted on a small scale, for garden culture for example, I consider the suggestion as unfit to be practised on a large scale on a farm; and especially as sets which are in a dry state when planted, are found to come up in the drill more equally, provided their vitality has been preserved. Small whole potatoes make good seed. One season, happening to have fewer sets cut than would plant the ground the dunghill allotted to the potato-land manured, some of the small potatoes which had been picked out for the pigs when the sets were cut, were planted to finish the land with potatoes, and the crop from them was better than on the rest of the field.

(2410.) Having drilled up as much land as will allow the planting to proceed without interruption, and having turned the dunghill in time to ferment the dung into a proper state for the crop, and having prepared the sets ready for planting, let us now proceed to the field, and see how operations should be conducted there, and in what manner they are best brought to a termination. The sets are shovelled either into sacks like corn, and placed in the field at convenient distances, or into the body of close carts, which are so placed on the headridges as to be accessible from all points. When the drills are short, the most convenient way to take the sets to the field is in a cart, as the distance to either headridge is short; but when the drills are long, sacks are best suited for setting down here and there along the middle of the land. A small round willow basket, with a bow-handle, should be provided for every person who is to plant the sets, and as a considerable number of hands are required for this operation, boys and girls may find employment at it, over and above the ordinary field-workers. A frying-pan shovel, fig. 176, will be found a

convenient instrument for taking the sets out of the cart into the baskets. Carts yoked to single horses take the dung from the dunghill to the drills. Graips, fig. 257, are required to fill the carts with dung. Small graips, such as in fig. 151, are most convenient for spreading the dung in the drills; and a small common graip is used to divide the dung into each of the three drills as it falls into the middle drill from the cart. A dung-hawk or drag, with 2 or 3 prongs, and about 5 feet long in the shaft, such as fig. 410, is used by the steward for pulling the dung out

Fig. 410.



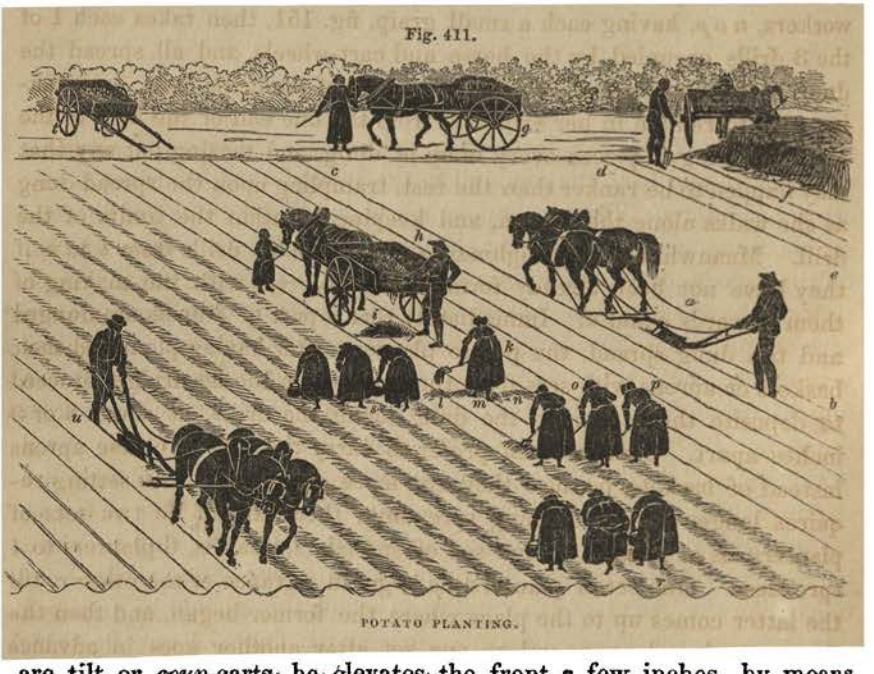
THE DUNG-HAWK OR DRAG.

of the carts. Boys, girls, or women, are required to lead the horse in each cart to and from the dunghill to the part of the field which is receiving the dung. The ploughmen, whose horses are employed in carting the dung, remain at the dunghill, and, assisted by a woman or two, fill the carts with dung as they return empty. One man, the grieve or steward, hawks the dung out of the carts, and gives the land dung in such quantity as is determined on beforehand by the farmer. Three women spread the dung equally in the drills with the small graips, while a fourth goes before and divides it into each drill as it falls in heaps from the carts. If the drills have all been made before, no plough is employed in that way while the other operations are proceeding; but ploughs are required to split in the drills and cover in the dung and sets as fast as the planting is finished. All these materials of labour being provided for their respective purposes, let them start to work; and to render your conception the better of the manner in which they should be arranged relatively to each other, I have contrived the annexed cut, fig. 411, which shews you at once how all the people and horses are employed.

(2411.) The first thing to be done is to back a cart to the dunghill *f*, and fill it with dung; and in doing this the carts are usually not quite filled, and the dung is heaped as near the back end of the cart as is convenient for the draught of the horse, that the man who hawks it out may have the less labour. The carts are filled, and the bottom of the dunghill shovelled clean by the ploughmen whose horses are employed in carting the dung; and whose number in the figure is 2, there being 3 carts employed at the dung: the men are usually assisted by a field-worker or two, in order to keep the carts a shorter time at the dung-

hill. Whenever the load is ready, the driver *c* starts with the horse and cart *g*, and walks them along the undunged drills, until the horse meets the steward, who places the horse and cart into their proper place in the drills, and then removes the back-board of the cart. To retain this board within reach, he places it upon its edge on the nave of the near wheel, where it is held from falling off by passing the small coterel, at the end of the chain attached to the back-board, into the slit-eye of the stud, which projects from the hind-end of the side of the cart, and which coterel and stud keep the back-board, when in use, fast in its proper place. If the carts are *whole*-bodied, the steward proceeds, after the back-board is removed, to hawk out the dung; but if they

Fig. 411.



POTATO PLANTING.

are tilt or *coup*-carts, he elevates the front a few inches, by means of the hesp attached there, that the dung may be hawked out the more easily. The wheels of the cart and the horse occupy 3 drills, as at *i*, the horse being in the middle drill between them. The steward *h*, with the hawk in both hands, pulls out a heap of dung *i* upon the ground, and it invariably falls into the middle drill. The horse is then made to step forward a few paces and to halt again, by the voice of the steward, who then pulls out another heap of dung. An active man, accustomed to this sort of work, does not allow the horse to stand still at all, but to walk slowly on whilst he pulls out the dung.

When the cart is emptied, the steward fastens down the body of the cart, if it is a coup one, puts on the back-board, and the cart again proceeds by its driver to the dunghill. When the distance to the dunghill is short, the carts are as slightly filled as to dispense with the back-board altogether; and when it can be wanted, labour is considerably expedited. After the cart has proceeded a few paces, and deposited a few heaps of dung, the foremost of the band of 4 women who spread the dung, as *k*, divides the heaps, as at *m*, with her small common graip into other two heaps, *l* and *n*, one in each of the drills beside her; and from *m* she goes to the next heap *i* and divides it into other two heaps, and so on with every heap of dung. The 3 field-workers, *n o p*, having each a small graip, fig. 151, then takes each 1 of the 3 drills occupied by the horse and cart-wheels, and all spread the dung before them equally along the bottom of the drills *l m n*, each taking care to remain in her own drill from the one end of the field to the other, shaking to pieces every lump of dung, and teazing out any that may happen to be ranker than the rest, trampling upon the spread dung as she walks along the bottom, and keeping it within the limits of the drill. Meanwhile, the ploughman *a* makes double drills from *b* to *c*, if they have not been already formed, and proceeds with the making of them towards *e* and *d*. Immediately that a part of 3 drills are dunged and the dung spread, the potato planters, after having plenished their baskets or aprons with sets from the cart *t* upon the headridge, proceed to deposite the sets upon the dung along the drills, at about 8 or 9 inches apart. Some women prefer to carry the sets in coarse aprons instead of baskets, because they are more convenient. As setting requires longer time than dung spreading, there should be two sets of planters, as at *r* and *s*, to one set of spreaders, that is, 6 planters to 4 spreaders. One set of planters, as *s*, go in advance of the other *r*, till the latter comes up to the place where the former began, and then the set *r* goes in advance, and so one set after another goes in advance alternately, each set filling their baskets and aprons as they become empty, but all confining their labour to 3 drills at a time. Whenever 3 drills are thus planted, the ploughman *u* commences to split the first and cover in the dung and sets in the double way. The drills are split in the same way as they were set up; that is, as the ploughman *a* turns over the first furrow of each drill upon the plain ground, stretching from *a* to *e*, so the ploughman *u*, in splitting the drills, turns over the first furrow upon the dung towards the planters *r* and *s*; because the *first* furrow being the largest, it should have

complete freedom to cover the dung and sets. If the land had been sufficiently worked in spring, so as to be tolerably clean and free at the time of planting the potatoes, the ploughman *a* may make up the drills in the single way, that is, making one drill in going away, as he is represented in the cut, from *b* to *c*, and returning with another drill in coming from *d* to *e*, because single drills will be sufficiently deep to contain the dung within them. Potatoes always receive a large dunging, they being in the first place a fallow crop, when the ground is entitled to be dunged, and, in the next place, they are considered a scourging crop to the land, that is, taking much nourishment out of it, and returning little or nothing to it—yielding no straw but a few dry haulms, and the greatest proportion of the entire crop being sold and driven away from the farm. A large dunging to potatoes always *seems* great, for time is wanting to make the dung short, and, of course, to reduce its bulk in the dunghill. About 20 single-horse loads, or 15 tons, to the imperial acre, is as small a dunging as potatoes usually receive of farm-yard dung. In the neighbourhood of towns, street-manure, to the extent of 30 tons per imperial acre, is given; but there the crop is forced for an early market, and the street-manure has not the strength of farm-yard dung, and indeed is found to be not nearly so good for them as for turnips. The spreading should be kept up as close to the cart as possible. The ploughman *u* should not leave a single drill uncovered in the evening when he gives up work. If he cannot possibly split all the drills in the double way, he should cover up the dung and sets of a few drills at the last in the single way; or he should receive assistance from the ploughman *a* to split them all completely, if he sees the weather shewing symptoms of rain or frost. And even at the loosening from work at mid-day, or forenoon yoking, every drill should be covered in, even though the ploughman should work a while longer in the field than the rest of the work-people; for which disadvantage he should be as long of yoking after them; and he should make it a point to cover in the drills at the end of the forenoon yoking in a complete manner, when the weather is hot and dry; because dung is soon scorched by the mid-day sun, and its dry state is injurious, not so much on account of the evaporation of any valuable material from it, the material being chiefly water, but because it does not incorporate with the soil so soon and so well as damp dung; and when both soil and dung are rendered hot and dry by exposure, their incorporation is rendered very difficult. If all the ploughs cannot cover in the drills within a reasonable time after the loosening time arrives, especially at night,

much rather give up the dunging of the land and the planting of the sets a little sooner than usual, than run the risk of leaving any dung and sets uncovered.

(2412.) You will observe that the process of planting potatoes, as represented in fig. 411, is composed of a variety of actions, which, taken individually, are equally important, and none of which can be carried on without the assistance of the rest, and all of which, if not proportioned to one another, would end in confusion. Thus, the ploughing of the drills, the dunging of the land, the spreading of the dung, the setting of the potatoes, and the splitting of the drills, are all equally important operations in potato-culture. None of them would be of any use without the rest. There would be no use of making drills unless they were to be dunged, nor would the planting of the sets avail unless the dung were spread, nor would the planted sets be safe, even on the spread dung, unless the drills were split to cover the whole from the weather. But if these component operations are not proportioned to each other, the whole operation is thrown into confusion. Suppose, for example, that the ploughman *a*, while making double drills, could not keep out before the party that is spreading the dung, it is evident that every other party would be constrained by his tardiness, and made to lose time; and the remedy for this inconvenience obviously is, that the ploughman should have as many double drills made before the dunging commences, as that he shall not be overtaken in the drilling; or that the ploughman should make single drills, when he finds the dunging gaining ground upon him; or that another ploughman should be sent to assist him in making double drills. Suppose, again, that more carts are employed in conveying the dung from the dunghill, than the steward *h* can possibly hawk out, or the 4 women *k n o p* possibly spread; or, the same effect would be produced by employing more people than necessary at the dunghill to fill the carts; the result would be, that the steward and women would be overworked, while the horses driving the dung, and the people at the dunghill, would be comparatively idle, and of course losing time. Suppose there are fewer planters at *r* and *s* than can keep out before the ploughman *u*, then time would not only be lost in covering up as many drills as might be, but the dung spread would lie exposed to the desiccating action of the sun and air between the planters of the sets and the spreaders of the dung. Were there, on the other hand, too many planters for those who spread the dung to keep out before them, then the planters would be comparatively idle. Suppose, lastly, that the ploughman *u* cannot keep up with the planters, who, nevertheless, do not proceed on their part faster than the dung is spread, the effect

will be, that the spread and planted dung will become dry before it can be covered up. The remedy for this inconvenience is, either to employ another ploughman to split in drills, or to make one ploughman cover the dung with one furrow, and let another finish the drills behind him at his leisure.

(2413.) I have dwelt the more fully on these particulars, because potato planting is one of those great operations which is made up of a variety of constituent operations that are performed simultaneously, and unless they form an harmonious whole, tending in all its parts to a common end, the entire operation cannot be completed in the best manner; but wherever this harmony is seen to exist, it is a satisfactory proof, that the person who has so arranged the working materials as to produce it, possesses the knowledge of combining varieties of field-labour. In effecting such an arrangement as the above, he displays knowledge of a superior order to that which is usually displayed in conducting potato planting. A very common mode of dunging potato-land, for example, is to hawk the dung out of the cart for 5 drills instead of 3, though 3, or even fewer, women are sent to spread the dung over them. In doing this, each woman's attention is not confined to a single drill, but must be extended over the whole 5, when each spreads the dung from the heap she takes possession of; and it stands to reason, that she cannot spread dung so *equally*, and of course not *so well, over* 5 drills as *along* 1; and the work is not done better, though faster, even though the 3 women are all employed to spread from the same heap, as each has still the entire 5 drills to attend to. Besides, when dung is hawked out of the cart for 5 drills, it is usually laid in large heaps at considerable distances, at from 5 to 10 paces apart, thereby increasing the difficulty of spreading; and a large space of the ground being thus heaped over, before the dung is begun to be spread, by the time it is spread, and the sets planted, the dung will have become quite dry. This plan may excusably be adopted on a small farm, where labourers are few, and it is desired to conduct operations with, what is considered, economy, by the employment of as few hands as possible; but on a large farm it has an appearance of great slovenliness, and it certainly encourages carelessness in work, and evinces confusion of ideas in arranging it. It is no uncommon sight, even on large farms, to see the dung carted out and spread in one yoking, and the sets planted and the dung covered in another, by the same people and horses; doing a great deal of work, no doubt, in each yoking and during the entire day, but the result would be much more satisfactory were the entire work finished as it proceeded. A great number of dunged drills are usually begun to be planted with sets at the same time,

instead of confining the setting to a few at a time, to get them finished as soon as possible, to be covered with the plough. In short, there is no end to the *many* ways in which field-work may be done in a slovenly manner; but there is only *one* best way of doing it.

(2414.) Drills of potatoes are recommended to be made at 30 inches apart, instead of 27 inches, which is the usual width for turnips, because the large stems of the potato-plant growing vigorously require plenty of air. Even 3 feet apart are recommended by some cultivators, and in deep rich soils this width may not be too great; but I observe that, in the neighbourhood of large towns, where the greatest extent of ground is occupied by potatoes, the drills seldom exceed 24 inches, owing partly to the great value of land in that locality, and partly because the earlier varieties of potatoes, which have small stems, are most profitable to cultivate there. The drills for potatoes are usually not made so *very* regular in width as for turnips, because the seed is not planted by a machine. It is very easy to ascertain whether the exact quantity of manure desired to be given to the potato crop is actually given. Knowing the length of the drill and its breadth, a simple calculation will inform you of the number of drills in an acre, and, by apportioning the number of cart-loads that should be applied on every 3 drills, the requisite quantity per acre can at once be ascertained with great precision; and this as precisely on the very first 3 drills that are commenced to be dunged, as if the calculation had been made over a large proportion of the field.

(2415.) As to the varieties of the potato I would recommend for field-culture, I find it impossible to tender an advice, because it would not be generally applicable. I have seen a potato transferred from England, where it was a favourite, to Scotland, another variety transferred from Scotland to England, another from Ireland to Scotland, and in each case produce a very inferior crop in its adopted country to what it ever did in its native one; and even in a transference from one part to another of the same country, I have seen a material effect produced upon the plant, increasing it in one case, and diminishing it in another. The general result is found to be an increase of produce and improvement of quality in transferring the potato from inferior to better soil, and from an elevated to a lower situation. The tendency of the potato to improve on being *thus* transferred, is taken advantage of in its attainment as seed. When I mention that there are upwards of 100 varieties of *field* potatoes described by Mr Lawson,* and as many experimented on by Mr Howden, Lawhead, East-Lothian,† you will not be surprised that I cannot

* Lawson's Agriculturist's Manual, p. 216–224, and Supplement, p. 52–5.

† Prize Essays of the Highland and Agricultural Society, vol. xi. p. 85.

confidently recommend any particular variety for a particular locality. Nevertheless a *good* potato has certain characteristics which distinguish it everywhere from an inferior one. A desirable potato is neither large nor small, but of medium size; of round shape, or elongated spheroid; the skin of fine texture, and homogeneous; and the eyes neither numerous nor deep-seated. The habit of growth of its stem is strong and slightly spreading, and colour lightish green. I believe that the intensity of the colour of the flower is in some degree an indication of the depth of the colour of the tuber; and I believe also, that white potatoes are generally fit to be eaten when taken out of the ground, but that red ones are the better for being out of the ground for a shorter or longer time, before being used, according to the fineness of their texture. But colour is by no means a fixed characteristic of any variety of potato, as it changes by cultivation and other circumstances. Mr Lawson relates a curious circumstance which gave rise to a permanent difference in the colour of the same variety of potato. "In the first report of Messrs Dickson and Turnbull's Agricultural Museum at Perth," he says, "a remarkable instance is given of a *white* variety of the Perthshire *red* potato, being obtained by Miss Bishop, New Scone, from a red potato with a white eye, which she carefully cut out and planted by itself, the result of which is, that the produce has for several years retained the same colour as the original eye, without the slightest appearance of change."* Before determining the properties of a potato in a locality, it is necessary that it exhibit the same character for 2 or 3 years in the same circumstances of soil, manure, and culture, otherwise errors may be committed in your estimation of varieties. The *intrinsic* value of a potato, as an article of commerce, is estimated by the quantity of starch which it yields on analysis; but as an article of domestic consumption, the *flavour* of the starchy matter is of greater importance than its quantity. Almost every person prefers a mealy potato to a waxy, and the more mealy it is usually the better flavoured. The mealiness consists of a layer of mucilage immediately under the skin, covering the starch or farina, which is held consistent by fibrous matter. Light soil raises a potato more mealy than a strong, and I suppose every one is aware, that a light soil produces a potato of the same variety of better flavour than clay. So that soil has an influence on the flavour, and there is no doubt that culture has, for potatoes, whatever may be the variety, raised from soil that has been dunged for some time, are higher flavoured than those grown in immediate contact with dung.

* Lawson's Agriculturist's Manual, p. 214.

(2416.) The most common varieties of potatoes cultivated in the fields in Scotland, are the Common or Edinburgh Dons, very plentiful in the Edinburgh market. It is round, and is an early variety; that is to say, the stems are entirely decayed by the time the tubers are fit for use. It produces about 16-fold of the seed, and yields 576 grains Troy of starch from 1 lb. of tubers. The Buff is a mealy and superior-flavoured potato, yielding about 15-fold, and 466 grains Troy of starch from 1 lb. of tubers. The Perthshire Red, an oblong flat potato, is largely cultivated for the London market. It yields about 15-fold, and affords as much as 777 grains Troy of starch from 1 lb. of tubers. Of the late varieties, that is those, the foliage of which, in ordinary seasons, does not decay until destroyed by frost, and the tubers of which generally require to be kept for some time before being used to the greatest advantage, the Staffald Hall, or Wellington, as it is sometimes called, is to be preferred. It is represented to yield 22-fold, and affords 813 grains Troy of starch from 1 lb. of tubers. The Scotch Black potato has long been cultivated in Scotland; and it seems to suit strong soil better than light, where it yields as high as 16-fold of increase, and affords 522 grains Troy of starch from 1 lb. of tubers.* Of the late varieties for field-culture suited for cattle, the Irish Lumpers and Cups appear prolific. The Lumper is a white oblong potato of very inferior flavour, but yields 421 bushels, and 3118 lb. of starch per *Scotch* acre I presume; and the Cups are an oblong red potato, yielding 479 bushels, and 3539 lb. of starch per acre.† On recommending any variety of potato, however, it should be understood that potatoes will not permanently maintain their pre-eminence at all places; on the contrary, a few years may witness their utter decline. The Leather-coats, for example, were a variety in very great esteem and in extensive cultivation some years ago, and now are hardly known. The small American white potato was extensively cultivated in the midland districts of Scotland about 20 years ago, but has yielded some of its ground to more prolific varieties. For the table, however, when raised in hazel loam—the true potato soil—there are few varieties cultivated superior to it in flavour, richness, and beauty as a dish. It is now, I believe, chiefly confined to the garden. The finest flavoured and most beautiful potato I ever saw on the table was a light red, small, round variety raised a few years ago in the sandy soil of the parish of Monifieth, in Forfarshire. It had quite the *nutty* flavour of a *fresh* Spanish chestnut—a state of that fine fruit unknown in this country.

(2417.) There are other ways of cultivating the potato in the field be-

* Lawson's Agriculturist's Manual, p. 216-23.

† Prize Essays of the Highland and Agricultural Society, vol. xi. p. 95.

sides the one I have described. When light soil, in which the potato thrives, is clean and in good heart, it is frequently dunged on the stubble in autumn, and ploughed in with a deep square furrow by casting with or without a gore-furrow, fig. 139. Abundance of gaw-cuts are made to let off superfluous surface-water in winter. It is then cross-ploughed in spring, and harrowed a double tine, when it is ready to be drilled up in the single form, the sets planted, and the drills split in the double form, to complete the operation. In the neighbourhood of towns this is an expeditious mode of planting a large breadth of potatoes in spring on light soil, but it requires the land to be in *very good heart.* I have tried it on good land in middling condition, but could not succeed in raising much more than half the crop produced from dunging the same land in spring.

(2418.) There is a modification of this plan which may be practised with success in very light soil, which is, that, after the cross-ploughing and harrowing in spring, the land is ridged again by casting without gore-furrows in the opposite way it was cast in autumn when the dung was ploughed in; and at every *third* furrow two women follow the plough, and plant the sets in the bottom of the furrow. If the furrows are held 9 inches wide, the distance between the rows of potatoes will be 27 inches; and if they are ten inches wide, the rows will, of course, be 30 inches apart; so that this plan admits of the rows being made wide enough.

(2419.) There is a sub-modification of this last method, which is, that the dung is spread over the smooth harrowed ground after the land has been cast into ridges in spring, instead of being applied on the stubble in autumn. The dung is raked in and spread evenly along the bottom of every *third* furrow by a woman with the small graip, fig. 151, following the plough, and immediately preceding the planters, and the plough which follows the planters covers up the sets. In both these modes the potato plants come up in *rows upon the flat ground* at the same distances they do in drills, and after their stems have grown up in summer, the earth is ploughed up towards them, so as to convert the flat ground into a drilled surface by the time the culture is finished.

(2420.) Another mode of the field-culture of the potato is in *lazy-beds*, a mode more generally practised in Ireland than in any other part of the kingdom. This system, however, will likely become less general, being much condemned by the good farmers there. Nevertheless, on lea-ground and on undrained bogs the small farmer cannot perhaps pursue a better one. "In bogs and mountains," says Martin Doyle, "where the plough cannot penetrate through strong soil, beds are the most conve-

nient for the petty farmer, who digs the sod with his long narrow spade, and either lays the sets on the inverted sod—the manure being previously spread—covering them from the furrows by the shovel; or, as in parts of Connaught and Munster, he stabs the ground with his *loy*, a long narrow spade peculiar to the labourers of Connaught, jerks a cut set into the fissure when he draws out the tool, and afterwards closes the set with the back of the same instrument, covering the surface, as in the case of lazy-beds, from the furrows. The general Irish mode of culture on old rich arable lea (a practice very common in the county of Clare, and elsewhere among the peasantry who pay dearly for old grass land), is to plough the fields in ridges, to level them perfectly with the spade, then to lay the potato sets upon the surface, and to cover them with or without manure by the inverted sods from the furrows. The potatoes are afterwards earthed once or twice with whatever mould can be obtained from the furrows by means of spade and shovel. And after these earthings, the furrows becoming deep trenches, form easy means for water to flow away, and leave the planted ground on each side of them comparatively dry." "The practice in the south of Ireland is to grow potatoes on grass land from 1 to 3 years old, and turnips afterwards, manuring each time moderately, as the best preparation for corn, and as a prevention of the disease called fingers and toes in turnips. In wet bog-land ridges and furrows are the safest, as the furrow acts as a complete drain for surface water; but wherever drilling is practicable, it is decidedly preferable, the produce being greater in drills than in what may be termed, comparatively, a broad-cast method."* The spade-culture of potatoes seems an appropriate mode for small farmers and cottars, but it is by far too expensive a mode to be introduced into a farm where horse-labour is employed.

(2421.) Whilst speaking of the form of the double drill, I have said that one of its sides was larger or heavier than the other; that is, the first furrow with which it is made is much larger than the second, the effect of which relation of furrows is to make the line of their meeting at the side instead of at the top of the drill, (2181.), and fig. 369. The germ of the potato, and of the bean too, in pushing upwards towards the top of the drill, finding the least resistance in the soil along the line of the meeting of the two furrows, finds its way to the day through the side instead of the top of the drill. Were the plants allowed to grow out from that part of the drill, they would not only be bent at the ground, but their stems would interfere with the horse-labour bestowed on the land in the

* Doyle's Cyclopedia of Practical Husbandry, art. Potato, p. 460, second edition.

hollows of the drills. To avoid this inconvenient and unnatural position of the plants, the practice is to harrow down the *tops* of the drills with harrows, so that the drill shall have the lightest part of the earth upon its crown; and, of course, the germ finding the least resistance directly upwards, will push out at the top of the drill. The harrowing down of the tops of the drills is executed with the common harrows, or with harrows made for the purpose. The common harrows are passed either along or across the drills, according to the nature of the soil. Strong soil bears the harrows being driven along the drills, and in very hard land, particularly in dry seasons, they may be passed along a double tine, but a single tine will usually be sufficient. Harrowing across, *with tines well worn down*, will have the least chance of disturbing long manure when used for dunging potatoes, as the drill which first receives the fore part of the harrow supports it and keeps the tines from penetrating too deep at once; but the walking across the drills is irksome both for man and beast, so that the harrowing is most easily performed along the drill. The common harrows, however, is a harsh implement for harrowing drills, compared to a couple of curved ones, figured below, which embrace two drills at a time, and which when pulled along do their work admirably. A modification of this last method has been recommended to be adopted on strong land in dry weather, after much rain has fallen, and when such land has become very hard and cloddy. A wooden roller, curved so as to embrace two drills, is recommended to be passed along, and by it the clods at top are either crushed or displaced to the bottom of the drills. Two pairs of harrows of a triangular form, suited to work in the hollows between drills, are then passed along, and they either remove the clods that were too hard to be broken by the roller, or they divide the large clods into a number of small ones, and bring them all, the clods of every kind, into the hollows of the drills. In every one of these modes of rolling and harrowing the drills of bean or potato land, the bean and potato germs are permitted to shoot perpendicularly up through their tops. This harrowing is given to the drills 8 or 10 days after the potatoes have been planted, if the land is dry, but, of course, it must be done before the germs have had time to penetrate the ground, although the weather be not altogether favourable for working heavy land. Of the two sorts of potato-harrows alluded to—the curved and triangular—the latter is best fitted to be used when the germs have appeared above ground, as its outmost tines work between the top of one drill and another, and not *over* the top of the drill like the curved harrows.

(2422.) The potato is subject to disease at a very early period of its existence, not merely after it has developped its stems and leaves, but

before the germ has risen from the sets. The disease which affects the plant is called the *curl*, from the curled or crumpled appearance which the leaves assume when under the influence of the disease. What the immediate cause of the disease is, it is difficult to say; but the puny stem and stinted leaves indicate weakness in the constitution of the plant, and, like weak animals affected with constitutional disease, the small tubers produced by curled potatoes, when planted, propagate the disease in the future crop. The curl is so well known by its appearance, and the curled plant so generally shunned as seed, that the disease is never willingly propagated by the cultivator; still there are circumstances in the management of the tubers which induce the disease therein. The experiments of Mr T. Dickson shew, that the disease arises from the vegetable powers of the sets planted having been exhausted by over-ripening, so that sets from the waxy end of the potato produced healthy plants, whereas those from the best ripened end did not vegetate at all, or produced curled plants.* It is the opinion of Mr Crichton, "that the curl in the potato may often be occasioned by the way the potatoes are treated that are intended for seed. I have observed," he says, "wherever the seed-stock is carefully pitted, and not exposed to the air, in the spring the crop has seldom any curl; but where the seed-stock is put into barns and outhouses for months together, such crop seldom escapes turning out in a great measure curled; and if but few curl the first year, if they are planted again, it is more than probable the half of them will curl next season." †

(2423.) The other disease alluded to affects the seed or sets, and is called the *failure* or *taint*, which consists of the destruction of their vital powers. Many conjectures have been hazarded as to the cause of the failure, and most of them have ascribed it to the fermented state of the dung, to the drought of the season, to the heating of the sets, to the tuber being cut into sets, and other secondary causes; but all these conjectures leave untouched the principal consideration in the question, how these circumstances should induce failure now, and not in bygone years? Cut-sets have been used for many years without causing failure. Farm-yard dung, in various states of decomposition, has been used as long for raising potatoes. The extraordinary drought of 1826 caused no failure, while in comparatively cool seasons the disease has made great havock. Mr John Shirreff takes a general and philosophical view of the cause of disease in the potato crop, and though, no doubt, his observations

* Memoirs of the Caledonian Horticultural Society, vol. i. p. 55.

† Ibid., vol. i. p. 440.

are particularly applicable to the *curl*, still they will apply equally well to the *taint;* for the connection between the two diseases is so intimate, that you have seen Mr Dickson's observation is, that some sets "did not vegetate at all," that is, *failed*, "*or* produced *curled* plants." Mr Shirreff adopts the general doctrine broached by Mr Knight. "The maximum of the duration of the life of any individual vegetable and animal," he says, "is predetermined by nature, under whatever circumstances the individual may be placed; the minimum, on the other hand, is determined by these very circumstances. Admitting, then, that a potato might reproduce itself from tubers for a great number of years in the shady woods of Peru, it seems destined to become abortive in the cultivated champaign of Britain, insomuch, that not a single healthy plant of any sort of potato that yields berries, and which was in culture 20 years ago, can now be produced." Mr Shirreff concludes, therefore, that the potato is to be considered a short-lived plant, and that though its health or vigour may be prolonged by rearing it in elevated or in shady situations, or by cropping the flowers, and thus preventing the plants from exhausting themselves, the only sure way to obtain vigorous plants, and to ensure productive crops, is to have frequent recourse to new varieties raised from seed.* The same view had occurred to Dr Hunter. The fact ascertained by Mr Knight deserves to be noticed,—that, by planting late in the season, perhaps in June, or even in July, an exhausted good variety may, in a great measure, be restored; that is, the tuber resulting from the late planting, when again planted at the ordinary season, produces the kind in its pristine vigour, and of its former size. It is obvious that all these opinions refer to the possibility of plants indicating constitutional weakness, and why may not the potato? I have all along been of the opinion, that the failure has arisen from this cause, nor does it seem to me to be refuted by the fact, that certain varieties of potato have been cultivated for many years in the same locality without fail; because it is well understood, that every variety of potato has not indicated failure, and one locality may be more favourable to retention of vigour of constitution than another; at least, we may easily believe this, and discrepancies in the case may arise, since we do not yet know the circumstances which must of necessity produce constitutional weakness. I have no doubt, in my own mind, that were seed-potatoes securely pitted, until they were about to be planted,—not overripened before they were taken out of the ground,—the sets cut from the crispest

* Memoirs of the Caledonian Horticultural Society, vol. i. p. 60. See also a well-reasoned essay by Mr Aitken, Castle-Douglas, entitled, "*The potato rescued from destruction, and restored to pristine vigour;*" and who takes the same view of the subject.

tubers and from the waxy end,—the dung fermented by a turning of the dunghill in proper time,—led out to the field, quickly spread, the sets as quickly dropped on it, and the drills quickly split in the manner represented in fig. 411, and described in (2411.), there would be little heard of the failure even in the driest season,—at the same time, the precaution of obtaining seed frequently from an elevated and late district compared to where the seed is to be planted, should not be neglected. I own it is difficult to *prove* the existence of constitutional weakness in any given tuber, as its existence is only implied by the fact of the failure; but the hypothesis explains many more facts than any other, than atmospheric influence—for example, producing the failure like epidemic diseases in animals, for such influences existed many years ago, as well as now. The longer the cultivation of the *tuber* of the potato, which is not its *seed*, is persevered in, the more certainly may we expect to see its constitutional vigour weakened, in strict analogy to other plants propagated by similar means; such as the failure of many varieties of the apple and pear, and of the cider fruits of the 17th century. This very season, 1843, contradicts the hypothesis of drought and heat as the primary cause of the failure, for it has hitherto (to June) been neither hot nor dry, while it strikingly exemplifies the theory of constitutional weakness, inasmuch as the fine season of 1842 had so much over-ripened the potato—farmers, still unaware of the cause of the failure, permitting the potatoes they have used for seed to become over-ripened—that the sets this spring, to repeat again the words of Mr Dickson, "did not vegetate at all," even in the absence of heat and drought, and in the presence of moist weather. Had the potatoes been a little less over-ripened in 1842, the sets from them might have produced only curl this season, though it is not improbable that the *same degree* of over-ripening may cause entire failure *now* that would only have caused curl years ago; and as over-ripening was excessive last year, owing to the very fine weather, so the failure is extensive in a corresponding degree in this, even in circumstances considered by most people preventive of its recurrence, namely, in cold and moist weather. And observe the results of both 1842 and 1843 as confirmatory of the same principle, illustrated by diametrically opposite circumstances. The *under*-ripened seed of the bad season of 1841 produced the good crop of potatoes of 1842, in spite of the great heat and drought existing at the time of its planting in 1842; while the *over*-ripened seed of the good season of 1842 has produced extensive failure, in spite of the coolness and moisture existing at the time of planting

in 1843. How can heat, drought, or fermenting dung account for these results?

(2424.) As fact, I may mention the effects of comparatively dry and moist soil, on cut sets and whole potatoes, which were brought to light by an experiment of Mr Howden, and which results obtained no one could have anticipated. "On the 28th June," says Mr Howden, "I selected from a store which had been repeatedly turned and kept for family use 70 potatoes of the old rough black variety. I divided this number into 5 lots, sizing them, so as each lot of 14 potatoes weighed exactly 4 lb. I made on that day one lot of 14 into starch, and obtained 9 oz. On the same day I put 14 potatoes whole, and 14 cut into 56 sets, into a deep box filled with *dry* mould. The remaining 14 whole and 14 cut I put into another box filled with *moist* earth, and which was watered from time to time. At the end of 3 weeks, with the exception of 5 sets, all the plants made their appearance. All this time the dry box had been kept from moisture. On the 21st July, however, I allowed it to be moistened with heavy rain, and on the 28th July, I took up and extracted starch from the whole. Before doing so, however, I weighed the several lots, and what seemed to me curious was, that each lot of the *whole* potatoes had *gained* 8 oz.; while each lot of the *cut* ones had *lost* 6 oz. of its weight, and of their number 10 did not vegetate. The *sprouts* from the *whole* potatoes weighed 4 oz., and those from the *cut* only 2 oz., yet the *starch* from the 28 *cut* potatoes was only 2 oz., and that from the 28 *whole* potatoes 9 oz., being exactly the produce in starch of half that number, namely, 14, which was made into starch at the commencement of the experiment."*

(2425.) The potato belongs to the natural order *Solanaceæ*, which also comprehends those remarkable but well-known plants, the deadly nightshade, the capsicum, the tobacco, the henbane, the stramonium, the tomato, &c. "The potato is now considered the most useful esculent that is cultivated, and who," Dr Neill asks, "could *à priori* have expected to have found the most useful among the natural family of the Solanaceæ, most of which are deleterious, and all of which are forbidding in their aspect?" The genus *Solanum* stands in the order *Pentandria monogynia*, of the Linnean system. "The name is given by Pliny, but the derivation is uncertain; some derive it from *Sol*, the sun; others say it is *Sulanum*, from *Sus*, being serviceable in the disorders of swine; and others from *Solor*, to comfort, from its soothing narcotic effects; all these conjectures are, however, improbable. *Solanum tuberosum*, the common potato, has roots bearing tubers; stems herbaceous; leaves unequally pinnate; leafets entire; pedicel articulated. It is a native of South America, on the west coast everywhere. The cultivated potato varies much in the leaves, colour of the flowers, shape and colour of the tubers, &c."† "Gerard," says Phillips, "de-

* Prize Essays of the Highland and Agricultural Society, vol. xi. p. 89.

† Don's General System of Botany and Gardening, vol. iv. p. 400.—*Solanaceæ*.

scribes two kinds of potatoes in his Herbal; and, as the account is highly interesting, I shall copy it *verbatim*. 'This plant,' says he, 'which is called *Sisarum Peruviorum*, or Skyrrits of Peru, is generally of us called potatus or potatoes. . . . The roots are many, thick and knobbed, like unto the roots of peonies, or rather of the asphodill, twined together at the top into one head, in manner of the skyrrit, which being divided into divers parts and planted, do make great increase, especially if the greatest rootes be cut into divers gobbets and planted in good fertill ground. . . . Of these rootes may be made conserves, no less toothsome, wholesome, and domestic, than the flesh of quinces. . . . These rootes may serve as a ground or foundation whereon the cunning confectioner or sugar-baker may worke and frame many comfortable delicate conserves and restorative sweet-meates.' . . . "This was evidently the sweet potato," continues Phillips, "which was supposed to possess an invigorating property. Kissing-comfits were made of them in Shakspeare's time. Falstaff says in the Merry Wives of Windsor—

'Let it rain potatoes, and hail kissing-comfits.'

Gerard commences his second chapter with the description of the common potato now in use, and says, '*Battata Virginiana sive Virginianorum, et Pappus*, potatoes of Virginia.' After an accurate description of the plant and flower, he adds, 'The roote is thicke, fat, and tuborous; not much differing either in shape, colour, or taste from the common potatoes, saving that the rootes hereof are not so great nor long, sôme of them round as a ball, some ovall or egge fashion, some longer, others shorter." The potato was introduced into Spain in the early part of the 16th century, and from thence spread over the Continent, first to Italy, then to Flanders, and thence through Germany to Austria in 1598. It found its way to England by a different route, being brought from Virginia by the colonists sent out by Sir Walter Raleigh in 1584 and who returned in 1586, and probably, according to Sir Joseph Banks, brought with them the potato. This palladium against famine was not cultivated in Scotland until 1683, and was then confined to the gardens. In 1728, Thomas Prentice, a day-labourer, first planted potatoes in open fields at Kilsyth, and the success was such that every farmer and cottager followed his example. Potatoes were scarcely known in the East Indies 30 years ago, but they are now produced in such abundance that the natives in some places make considerable use of them. Bombay is chiefly supplied with this excellent root from Guzerat. And though the cultivation of this root is much increased in France within these last few years, the poor of that country cannot yet be prevailed on to eat it."*

(2426.) Rooks are very destructive to the potato-crop just as the germs of the plants are penetrating the ground, and they seem to possess an exquisite sense of smelling to find out those which are most palatable to their taste. They steal very quietly into potato-fields, and are there pretty well hidden amongst the drills; and in this respect their tactics differ from what they pursue when alighting amongst growing corn, which they do in large flocks. There is nothing but gunpowder will deter them from a potato-field; they soon find out the innocuous character of a scarecrow or *tattie-doolie*, as that sorry semblance of humanity is always misnamed. One cannot always be firing amongst crows with the gun, but an occasional shot does good, aided by that effectual check to their visitation

* Phillips' History of Cultivated Vegetables, vol. ii. p. 81-104.

of any field—the burning of gunpowder matches here and there and now and then along the windward side of the field, the fumes of which sweeping along the surface of the ground, being smelt by the rooks, put them in constant *trepidation*, and at length to flight.

(2427.) It may prove interesting to those of you who may possess a farm in the neighbourhood of a large town, to know why it is that the street-manure of towns is not so suitable for raising potatoes as stable or byre manure. A paper on the subject by Dr Madden enables me to give you an idea of the explanation he gives of the subject; and to enable you, in the first place, to judge of the nature of street-manure, I will insert a part of a table of his construction, shewing the chemical difference between it and horse and cow dung.

	MANURES.		
	Stable.	Byre.	Street.
Water, &c., ...	13.5	45.7	26.4
Organic Matter—			
Soluble in Water, ...	11.5	9.0	1.4
Soluble in Potassa, ...	15.9	12.6	1.0
Destroyed by Heat, . . .	13.33	21.8	11.2
Saline Matter, ...	45.77	10.9	60.0
	100.00	100.0	100.0

The sum of the *chemical* nature of these three substances used in raising potatoes is, that *stable-dung* is the most heating, but not so durable—that *byre*-dung is *cooler*, and much more lasting—and that *street*-manure is very inferior to the other two in every respect, and, in fact, would be little better than soil, were it not for the highly azotized nature of its organic matter, and probably also for the presence of a considerable quantity of chalk. The effect of applying street-manure to the soil is this: "When any quantity of street-manure," says Dr Madden, "is ploughed into good soil, the following changes take place:—The ordure and carbonate of lime, which are evidently the most powerful ingredients of this manure, will react upon the less decomposable organic matter, both of the soil and of the manure itself, and thus bring the whole into a state of fermentation, the extent and intensity of which will be regulated by the quality of these active ingredients, especially the ordure. This action depends upon the fact, that when any organic substance in a state of fermentation is brought into contact, or mingled with any organic matter capable of fermenting, but not at present in that condition, the whole mass, after a time, undergoes the same series of changes, which are always accompanied with the escape of various gases, and the formation of certain soluble compounds, which latter constitute the chief food of plants. Moreover, it has been long ago proved, that substances rich in azote are always the most prone to decomposition, and likewise are capable of exciting fermentation to a far greater extent in others of a less putrescible nature. Again, it is well known to farmers that chalk or carbonate of lime possesses the power of increasing the putrescent tendency

of many vegetable substances, so that, when applied to soils, it renders them *richer*. But what is curious enough, at the same time that it causes the production of soluble matter by promoting putrefaction, it renders less soluble those portions already in a state of solution, by entering into chemical combination with them. On these accounts, therefore, and especially from the ordure being a very highly azotized substance, street-manure will be capable of exciting putrefaction to a greater extent, considering the small quantity of organic matter which it contains, than one at first sight would be led to suppose. It must, however, be remembered, that as the putrescent effect will only be produced in the immediate neighbourhood of the active ingredients themselves, and as, moreover, these are mixed with a large quantity of other comparatively inert matters, their action is very liable to be confined to certain spots. Owing, likewise, to the presence of cinders, a certain portion of the soluble organic matter will be absorbed by them, and thus for a time, at least, removed beyond the reach of plants. But, on the other hand, it will be observed, that, from the highly azotized nature of its organic contents, the fermentation will be *rapid at the first*, and, consequently, the manure will be hot in proportion to the quantity of real manure which it contains." In the actual effect of this manure in raising potatoes being $\frac{1}{3}$ inferior to stable and byre dung, the following explanation of its inferiority is offered by Dr Madden. " In the account of the culture of the potato, given in Professor Low's excellent work on Practical Agriculture, we find the following expressions:—' Dung will in all cases act most quickly upon young plants when it is well prepared, but extreme preparation of the dung is *not required* in the case of the potato. It is enough that it should be in *such a state of fermentation as that it may be readily covered by the plough.*' Thus proving that this plant does not require an instant supply of a considerable part of soluble matter. And, moreover, it is clear, that as the useful part of this plant is produced during the *later* periods of the growth of the crop, the greatest supply of food will be necessary at that time. But we have already shewn, that street-manure, from the nature of its constituents, ferments very *rapidly at first*, and, consequently, its *greatest effects* will be in the very *early* periods of the growth of the crop. The next sentence in Professor Low's work commences thus:—' The potato requires a *large supply* of manure.' But we have already shewn, that street-manure does not contain $\frac{1}{3}$ as much *real manure* as either that derived from dairies or stables. And a little below the above quotation occurs the following sentence:—' *Lime* does *not* appear to act in a *beneficial* manner, and is *rarely* applied directly to this crop.' But our analysis has proved that lime exists in considerable quantities in the street-manure of Edinburgh; and as it has been exposed to great heat—for it is evidently derived from the ashes—it will, of course, be in the same state as *mild lime* when it is applied, and will, most probably, therefore, have the same effect, which, according to Professor Low, is ' *not beneficial.*' The potato possesses a spreading root, and, consequently, must require a *uniform manure*, in order that all its parts may be equally supplied with soluble organic matter. But we have before shewn that street-manure is *partial*. The potato requires the greatest quantity of azote at the *later periods* of its growth; because the tubers contain considerably more of that substance than the leaves. But street-manure, from the nature of its organic constituents, will ferment rapidly, and allow most of its azote to escape during the *early* periods of the cultivation of the crop." As a general rule for the application of manure to potatoes, " We may hence argue," as Dr Madden re-

marks, "that a manure, to suit well for the potato-crop, should possess the following qualities:—It must be spread equally through the soil, so that the spongioles, at the termination of all the *spreading fibres* of its roots, may be supplied with nourishment." And surely there is no way of spreading dung so equally as along only three drills at a time, and by spreaders keeping to their own drills. "It must yield azote during the *whole* period of the growth of the plants; in fact, rather more is required during the *later* periods than prior to the development of the tubers; for, from M. Boussingault's analysis, it appears that they contain $\frac{5}{100}$ per cent. more of this substance than the leaves. In an economical point of view, therefore, the best manure for potatoes would be one which contained plenty of azote, but still did not decompose very rapidly,—cow-dung, for example."*

(2428.) [*The Grubber.*—The grubber, or, as it is frequently styled, the *cultivator*, is a comparatively modern implement, and seems to have sprung from that more ancient prototype, the brake-harrow, which it has now to a considerable extent superseded. It is in principle a member of the harrow tribe of implements; but while the harrow, or even the brake, acts superficially or to a very small depth in the soil, the grubber, from its greater weight, and from the form of its tines, penetrates the ground to any required depth. In respect to penetration, therefore, it approaches the plough, but its effects are simply to stir the soil, tearing up roots of plants at the same time, but produces no effect towards turning it up like the plough. It has been supposed that the grubber may be traced so far back as the days of the Roman agriculturists, but there is good reason for assuming that the instrument used by them partook more of the brake than the grubber, and so far as has been traced in modern works, its application, in Scotland at least, goes no farther back than the year 1784, at which period an implement, then styled an *edgit*, of the grubber family, was in use by several agriculturists in the neighbourhood of North Berwick, East Lothian.† From this period the grubber appears to have lain comparatively dormant till 1811, when the late Sir John Sinclair brought it in a tangible shape before the Dalkeith Farming Club; Sir John at that time described it as being known in England by the name of the Scarifier. As might naturally be expected, therefore, it seems to have been an importation from England, but, like other implements and machinery already noticed, it came to a higher degree of perfection here than in its original soil, and it is only very recently that the newest forms of the grubber have appeared in England. Many years after, Finlayson, Kirkwood, and others, cleared away the rubbish, and brought out those essential characters of the implement which have not yet been superseded except in minor details. The original Scotch form of the grubber of 1784 appears to have been a wooden frame, in which, Mr Shirreff says, "The tines were fixed, standing perpendicular, the point not dipping but forming a right angle with the tines. The wheels were only two; these stood in front of the machine, and being movable upwards and downwards, regulated the depth to which the tines were intended to work."‡ The improved form of 1811 is figured in the Transactions of the Highland and Agricultural Society and other works of the period,§ but still constructed in wooden frame-work; and having now four wheels, immediately supporting an external frame, to which was jointed another and

* Prize Essays of the Highland and Agricultural Society, vol. xiii. p. 359-70.

† Ibid, vol. iv. p. 571. ‡ Ibid. § Ibid.

internal frame carrying the chief part of the tines, it became better adapted to being raised out of the ground at pleasure.

(2429.) The next great step in the improvement of the grubber was made by Mr John Finlayson, farmer at Kaims, in the parish of Muirkirk, Ayrshire, who, about the year 1820, brought out his *patent self-cleaning harrow* or grubber, but it does not appear that he actually procured a patent for the improvement. It was now made entirely of iron, and became a very effective implement, though cumbrous, and attended with some inconveniences arising from a deficiency in the means of raising the tines out of the ground. Subsequent to the improvement by Mr Finlayson, Mr James Kirkwood, Tranent, East Lothian, made some further improvements on the patent self-cleaning harrow of Finlayson, and ultimately, in 1830, brought out a grubber differing materially from the former, and possessing properties that placed it superior to the other, the chief of which was the easy and perfect manner in which the whole of the tines could be raised from the ground. Various other modifications were soon after brought out by different makers, among which I cannot omit mentioning that of Mr Wilkie, the well-known ploughmaker at Uddingston. Mr Wilkie's grubber is a very elegantly-constructed machine, possessing the self-cleaning principle in the tines; but, from its elaborate construction, its necessarily high price has probably been a bar to its more extensive introduction. Amongst these modifications, Finlayson's original grubber again underwent a marked improvement, in which, though the original shape has been preserved, a perfect mode of raising the tines from the ground has been engrafted upon it.

(2430.) While these later improvements have been going on in Scotland upon this implement, corresponding exertions have been successfully made in England, where the improvements above alluded to have not only been followed, but are in some measure surpassed, under the names of Cultivators and Scarifiers. Amongst these, that of Lord Ducie stands pre-eminent, with Biddel's and others following close upon it.

(2431.) Such are a few leading points in the history of the grubber, and its progress to the present improved state. It is, and will continue to be, an important implement, whether for the working of summer fallow, the preparing of rough or foul land for green fallow, or for the purifying of land that has been suffered to become so foul as to be incapable of producing a crop in the ordinary mode of cultivation. Soils in the last mentioned condition, by passing through a course of grubbing that may be done in a few days or weeks at most, may be brought into a crop-bearing state. The grubber, like many other novelties, was, on its re-introduction about 1811, held up as an implement capable of producing an entire revolution in the cultivation of the soil,* and was spoken of as something above human invention, superseding even the plough; it has now settled down into its proper sphere of usefulness, ranking at least next to the plough.

(2432.) It will be unnecessary to attempt going into details of all the forms of the grubber, more especially of those early forms which are now entirely exploded; even the original of Finlayson's may be passed over as now obsolete, but which may be seen figured in the works of the day.† I shall, therefore, proceed to describe some of those that have attained a character which they are likely to

* See, for example, Beatson's New System of Cultivation.

† In the Quarterly Journal of Agriculture, vol. ii. p. 846.

retain; and of these, though it may not be in exact chronological order, Finlayson's harrow improved, may be taken as the first in the order of description. This implement dates no farther back than the year 1836.

(2433.) *Finlayson's Harrow or Grubber.*—Fig. 413, Plate XXIX, is a view in perspective of Finlayson's harrow of the improved form. The framework and the active parts are precisely the same as when the implement was manufactured under the patent, the improvement lying in the parts, which have been introduced for raising the tine-frame from the ground. The figure represents the implement as carrying seven tines, and consists first of the body-frame, which is formed of two interior oblong frames $a'\ c'$ and $d'\ a$, each 4 feet 6 inches in length, and 12 inches in width over all. These frames are welded solid at the angles, and rectangular; the sides a' and d' are 3 inches in depth, and $\frac{3}{4}$ inch in thickness, and are perforated to receive the tines at their full strength, whether of a square or oblong section; the bars a' and d' are therefore allowed to swell out on both edges at the perforation, to preserve strength. The sides c' and a, together with the ends of these frames, are only $2\frac{1}{2}$ inches in depth, and $\frac{5}{8}$ inch in thickness, and the perforations are only sufficient to pass the screwed tail of the tine. The side-bars $a\ a$ and $a''\ a''$ are bolted upon the ends of the interior frames, as seen in the bar $a''\ a''$, and each is prolonged forward from a and a'' to the point b, forming the triangular prolongation $a''\ a''\ b$, and are connected by a bolt at b. These side-bars are $2\frac{1}{2}$ inches in depth, $\frac{5}{8}$ inch in thickness in the parts $a\ a$ and $a''\ a''$, while in the triangle they are reduced to $\frac{1}{2}$ inch in thickness, and the distance from a', the front of the body-frame, to the apex b of the triangle, is 4 feet 6 inches.

(2434.) The tines are always in this machine made of the swan-neck or self-cleaning form. They consist of the shank f', by which they are fixed in the interior frame, and of the prong m, which penetrates the ground. A cross section of the swan-neck and shank is either a square of $1\frac{1}{2}$ inch, or it is an oblong of $2\frac{1}{4}$ inches by $\frac{7}{8}$ inch, some makers adopting the square, which was Finlayson's original form, while others adopt the oblong. The shank diminishes from the neck towards the tail, which terminates in a $\frac{3}{4}$ inch screw, by means of which and a nut the tine is held firmly in its place. The prong or forward end of the tine diminishes gently in depth to the extremity, which terminates in a chisel-shaped point of $1\frac{1}{2}$ inch broad, having a slight inclination earthward, without which the implement has a tendency to rise out of the ground.

(2435.) The body-frame, with its tines, is supported on the two hind-wheels $d\ d$, 20 inches diameter, which are mounted on the cranked-axle $f\ e\ f$, and upon the front castor-wheel g, of 12 inches, the former turning upon studs in the cranks f' and the latter in the sheers h. The axle e is supported in brackets, bolted upon the inside of the side-bars $a\ a$ and $a''\ a''$, as seen in fig. 412, where $a\ a$ is the side-bar, and e the bracket, the eye of which, for receiving the axle, stands $3\frac{1}{2}$ inches above the upper edge of the bar, and its thickness is $\frac{3}{4}$ inch. The sheers h, fig. 413, of the fore-wheel are jointed into the bent lever at i, forming a bell-crank-lever $i\ k\ l$ by which the fore-part of the machine is elevated or depressed. The hind-part is acted upon directly by the lever $n\ n$, which is also bent at n to nearly a right angle in the arm $n\ o\ e$, the extremity of which passes through the axle at e, and is secured with a screw-nut. This form of the lever, $n\ n\ e$ is rendered, in its effects upon the hind-wheel and axle, a simple straight lever; but the angle which it forms at $n\ o$ serves an essential purpose,

as it affects the fore-wheels. It will be observed that the arm *n o e* takes a position nearly parallel to the arm *k l* of the fore-crank, and by the introduction of the connecting-rod *n p l*, jointed to the lever *n n e*, and to the crank *i k l*, by this arrangement, whatever motion is communicated through the lever *n n e*, to the cranked-axle of the hind-wheels, a corresponding motion is simultaneously given to the fore-crank and its wheel, whereby the tine-frame is uniformly raised or depressed at pleasure. The lever *n n e* is about 5½ feet in length, and is under the control of the conductor; its position in the figure indicates the highest position that the tine-frame can attain; and to enable the conductor to retain it in any required position, the quadrant *q r*, with its upright support *s r*, is bolted upon the back frame *d' a*; the edge of the quadrant-bar is notched with serratures about ½-inch deep, adapted to receive and retain the edge of the lever, as seen in the figure, occupying the lowest notch, which brings the tines entirely out of the ground. By removing the lever from this notch and putting the machine in motion by the horses, the tines immediately descend into the soil, and when they have attained the required depth the lever is laid into the notch suited to that depth, and the machine proceeds thus until the attendant sees it necessary to withdraw the tines from the ground, which must be done at every lands-end, or oftener if obstructions are met with.

(2436.) Fig. 412 is a geometrical elevation of the grubber to shew more distinctly the relation and action of the elevating apparatus, the solid lines exhibiting the machine with the tines *m* and *m* nearly at full depth in the soil below the surface line, and the repetition of the figure in the dotted lines shews it when the tines are fully raised out of the ground. In the first position, *a a b* is the tine-frame, *e* the brackets that support the crank-axle, and *f* the crank carrying the hind-wheel *d*. The fore-crank, including the sheers of the fore-wheel takes the position *i k l*, and the back lever, which is broken off at *n'*, has the position *n' o e*, *o p l* being the connecting-rod. It will be easily seen that *e o l k* approaches to a parallelogram, and theoretically it ought to be such, but from matters of convenience to suit the diameter of wheels, the side *o e* is usually made shorter than the side *l k*, and, to compensate for this difference, the arms *f' f* and *i k* of the cranks are made proportional to the arms *o e* and *l k*; and as these are the members of the machine by which the elevations and depressions are produced, and being connected by the rod *o p l*, the arms *o e* and *l k* will move through equal *lengths* of arc, but with unequal angles, the proportional arms *f' e* and *i k* will describe corresponding arcs and angles, and so produce a nearly parallel rise and fall of the tine-frame moving round the centres *f'* and *h* of the hind and fore wheels, fig. 413. In this complicated combination of levers, it will be observed that the principal lever *n' o e*, fig. 412, from its combination with the crank *e f'*, is in effect resolved into a simple lever of the first order, whose fulcrum is *f'*, its power is in *n'*, and the point of resistance in *o*; for though kneed at *o*, and re-kneed at *e*, yet, from its construction, the parts *n' o e f'* form one rigid system, and the result is the same as if a rigid bar were extended from *n'* to *f'*, and then from *f'* to *o*, but in which case a jointed bar must fall from *o* to *e*, to bear up the tine-frame.

(2437.) In this, fig. 412, the dotted lines represent the changed position of all the parts where the tine-frame has been raised to its utmost limit; the same letters, with an *accent* annexed, mark the position of the different points; and here it will be further observed, that the change of position takes place by the parts turning about the centres of the hind and fore wheels.

(2438.) This form of Finlayson's harrow or grubber is a very well-marked improvement on the original, arising from the facility now afforded of raising the whole of the tines out of the ground. In the original form, the only provision of this kind that the machines possessed, was the elevation of the apex *b* of the triangle, and with it, a partial elevation of the fore-tines, while those behind remained always in the ground at their working-depth. It is true, that this depth could be varied, but only by shifting a bracket that carried the axles of the hind-wheels, and the adjustment of them was a work of considerable time; a screw in some cases was attached to each bracket, by which it could be raised, but they were at best tedious and inconvenient compared with the new form of the elevating apparatus. The original harrow was, in consequence of this defect, a much less manageable machine, and having four of its tines always in the ground, it was much more liable to accident and to fracture. With the improvement also of the elevating apparatus, the bulk and weight of the implement has been reduced, and it is now very frequently used with five tines, in place of the original seven-tined implement as here figured with the improvements.

(2439.) *Kirkwood's Grubber.*—Though in point of time, this instrument was introduced prior to that just described, it was several years later than Finlayson's original improved harrow, or about 1830.* In this machine the ingenious apparatus for elevating the tine-frame was, I believe, first brought out, and from it, has been deduced all the various forms in which this effect is now produced, though, as we shall see, some of them are so much changed from the original, as hardly to be recognisable; still, the elements of the original are there, obtained in some cases at a greater, in others at a smaller, expense. The present form, as figured here, differs in some minor points from the original, but not so much as at all to alter the character of the implement, which is still essentially Kirkwood's, though the figure is taken from those manufactured by James Slight and Company, Edinburgh. The chief points of difference are in the length of the axle of the hind-wheels; this, in the original, was so short, as to bring the wheels close to the levers: in the figure the axle is extended so far as to place the wheels on the outside of the extreme tines. This extension of the axle gives the machine a broader base, and thereby a greater steadiness of motion, and to compensate for, and give support to, the extremities of the axle thus extended, it is supported by a trussed-tie with king-posts.

(2440.) Fig. 415, Plate XXX, is a view in perspective of this grubber; it may be considered as consisting of two parts, the tine-frame, and the carriage with its wheels and handles, the two being connected by means of the apparatus for elevating the tine-frame, and by a joint-rod which is common to both, the whole being constructed of malleable iron, except the wheels. The tine-frame is of an irregular triangular figure, composed of two sides *a a a*, &c.; these are forged to the peculiar form represented in the figure, and to the following dimensions; from extreme *a* to *b'* in the oblique straight line, the distance is 25 inches, *b'* to *c'* 21 inches, and *c* to *a''* 39 inches; and the lengths on the opposite side correspond exactly with these; but the central distance from extreme *a* to *a''* is 6 feet 6 inches. The breadths measuring from centre to centre of the tines are at extreme *a* 4 feet 2 inches; *b'* to *a* 2 feet 10 inches, and *c'* to *a* 17 inches; the fore-part of the bars forming the neck, approach to within ¾ inch of each other, between the points *d'* and *m*, and at *a''* they come in contact,

* Prize Essays of the Highland and Agricultural Society, vol. viii. p. 131.

and are fixed by the bolt at a''; the muzzle $a''\ z$ is simply a prolongation of the bars, and is provided with several holes in which the draught-shackle and hook can be attached to regulate in some degree the tendency to earth. That part of the frame d' to m, forming the neck, is raised 9 inches above the line of the body, measuring from the upper surface of the one to that of the other, and lies parallel with the body of the frame. The side-bars here described are $2\frac{1}{4}$ inches in depth and 1 inch in breadth, till they approach d', when they are diminished in breadth to $\frac{3}{4}$ inch, and go on diminishing to $\frac{1}{2}$ inch at a''; the slot-holes for the tines are $2\frac{1}{4}$ inches by $\frac{3}{4}$ inch. Besides the connection at the point a'', the side-bars are connected by the joint-rod g, which is $1\frac{1}{2}$ inch square at the middle, tapering and rounded towards the end, where it terminates in a screw and nut of about 1 inch diameter; and a light stretcher a' is also inserted as a further support to the frame. The beam $b\ b$ is $2\frac{1}{4}$ by 1 inch from b to u, and diminishes from u to d' to $\frac{3}{4}$ inch; it is kneed at extreme b, so as to leave space sufficient to receive the slot-hole for the middle tine, and it is bent upward at u to the height of 10 inches above the frame as before, for the purpose of receiving the bridle $u\ u'$; the end b of the beam is notched into the middle of the joint-rod g (which is here spread out to 2 inches in depth), and fixed by a screw-bolt, tapped into the end of the beam, while its fore-end is secured between the side-bars by a through bolt at d'. The tines, of which this form of the implement contains seven, $h\ h$, &c. are $1\frac{3}{4}$ inch by $\frac{3}{4}$ inch, bent at the point as in the figure, with a slight tendency to *earth*, and are flattened out at the point to a breadth of $1\frac{1}{4}$ to $1\frac{1}{2}$ inch; their length from the level of the point to the top is 20 inches, and they are secured at any required degree of earth by one iron wedge to each tine.

(2441.) The carriage consists of the axle $d\ d$, on which are mounted the two handles or levers $c\ c\ o$, the axle passing through these, and fixed with cotterels on each side. At the distance of $13\frac{1}{2}$ inches from the centre of the axle, the levers are also perforated for the joint-rod g, the position of which in the tine-frame is such as just to allow the extremities a to pass the axle when the frame is being raised or depressed. A third perforation is formed in the fore-end of the lever at o, 2 inches forward of the joint-rod, for the attachment of the stays. The levers extend backward to a length of $4\frac{1}{2}$ feet, and terminate in sockets into which wooden helves are inserted; and they are further supported by the stay-rod and bow c'. The carriage is now supported on the hind-wheels $f\ f$, of 22 inches diameter; and the fore-part of the frame on the castor-wheel i, of 13 inches diameter, with its sheers $k\ l$, and crank-lever $l\ m\ n$. The connections between the carriage and frame, and which also form the elevating apparatus, is arranged in the following manner. The right and left stay-rods $o\ p\ q$ and $r\ p\ s$ are bolted to the levers at $q\ o$ and $r\ s$. The perpendicular distance $g\ p$ being 12 inches, and the like distance from the centre of the axle d to p $18\frac{1}{2}$ inches, the two stays being brought together upon a stretcher-bolt at p, of 1 inch in length, having a screw and nut at each end. The connecting-rod $p\ t\ n$ is 5 feet $2\frac{1}{2}$ inches in length, $\frac{3}{4}$ inch diameter, and is jointed to the carriage by the short stretcher-bolt at p, and to the lever of the front-wheel at n, which completes the arrangement by which the tine-frame is moved up and down in positions always parallel to the horizon.

(2442.) Fig. 414, Plate XXX, is a geometrical elevation of this grubber, shewing, in a more distinct manner, the relation and action of the elevating apparatus. In this the solid lines represent the machine as with the tines in the

ground, the surface being represented by the line $x' x''$; and the repetition of the figure in *dotted lines* represents it as when the tines are elevated, and the machine in a travelling condition, the same letters applying in both positions, but in this with an *accent*. In the first position, applying the same letters as in the former figure, *a a*, &c. is the tine-frame, *b* the beam, *c* the handles or levers, *d* the axle of the carriage, *f* the hind-wheels, *g* the position of the joint-rod of the tine-frame, and *h h* are the tines. The front-wheel is shewn in the sheers *k l*, and *l m n* is the crank-lever, *g p r* is the stays, and *t* the connecting-rod.

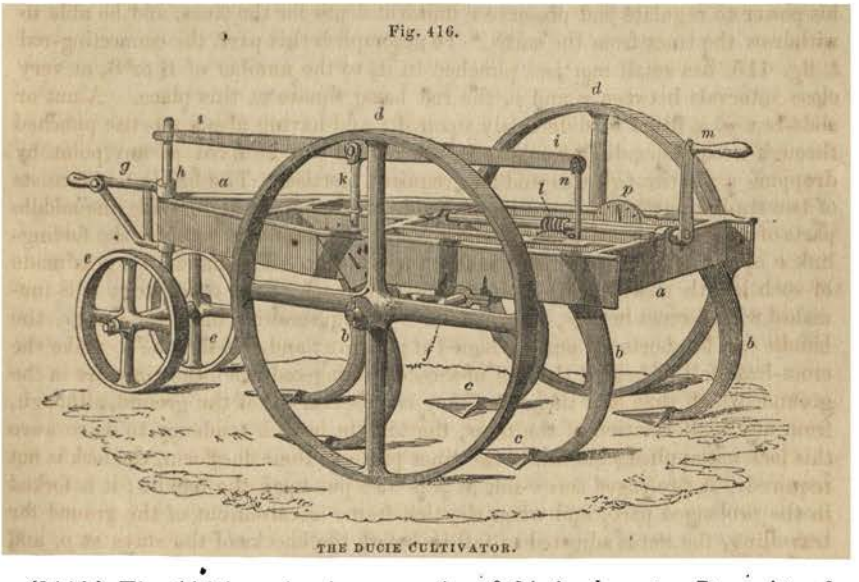
(2443.) In the apparatus of the front-wheel, the distance from the sole of the wheel, where it touches the line $x' x''$, to the centre at *m*, is 23 inches, and from *m* to *n* $11\frac{1}{4}$ inches; and as the carriage lever, though in a complicated form, is resolvable into a more simple one, which has the same proportions as the former, the point where the wheel touches the line $x' x''$ is the fulcrum, and a line drawn from the point x' to the joint at *p* will be parallel with, and equal to, $x'' m$, and *g p* will be equal to *m n*; and the point *p*, *n* acting simultaneously, by means of the connecting-rod *t*, the point *p* rises by turning round the fulcrum x', while *m* rises through the same space by the point x'' turning round the point *m* in the opposite direction. By these motions the tine-frame will rise and fall through equal spaces before and behind, and thus preserve the parallelism of the frame in any position.

(2444.) In working the machine it is requisite that the conductor have it in his power to regulate and preserve a uniform depth for the tines, and be able to withdraw the tines from the earth. To accomplish this part, the connecting-rod *t*, fig. 415, has small mortises punched in it, to the number of 6 or 8, at very close intervals between *u* and *p*, the rod being square at this place. A nut or slide-box y' is fitted to slide easily upon it; and having also a mortise punched through it corresponding to those in the rod, it can be fixed at any point by dropping a pin through this and any required mortise. The bridle $u u'$ consists of two similar parts bolted one on each side of the beam; and having the middle parts of its stay widened to admit the passage of the nut, it receives the folding-link *v* upon the bolt, on which the link turns freely. The handle *v x w* is made of such length as will bring the eye *w* within reach of the conductor; it is furnished with a cross-head *x*, and the end *v* being screwed into the link *v*, the handle can be shortened or lengthened at pleasure; and this is done to make the cross-head fall in behind the end of the connecting-rod when the tines are in the ground, which thus lock them that they cannot rise out of the ground, although, from any malformation of the tines, they might have a tendency to do so were this lock not applied; but while the tines preserve their due form, the lock is not required. A prolonged screw-nut at *p* is also put upon the handle; it is forked in the prolonged part; and when the tine-frame is raised out of the ground for travelling, the nut is adjusted to fall in before the checks of the stays at *p*, and thus keeps up the tine-frame without the continued aid of the conductor.

(2445.) *Ducie's Grubber*, or cultivator, the production of Earl Ducie, is based, in its construction, on the improved form of Finlayson's and of Kirkwood's grubbers. It possesses the good and useful qualities of these implements, together with some improvements of its own, besides embracing the high wheels of Wilkie's grubber. This combination of the good points of several previously existing implements, coupled with additional improvements, makes this a fine example of the value of close observation, and of the concentration of such observed facts. In Earl Ducie's cultivator we have the

high wheels raising the tine-frame to a height above the surface of the ground that must greatly prevent the choking of the tines in foul land, by the accumulation of roots about their neck; and this is further secured by the curvature which they possess. Here they have the self-cleaning qualification of Finlayson's, with the simplicity and strength of Kirkwood's, while the height of the frame above the ground gives scope to the effects of the curvature. The castor-wheel in front, which, in the Ducie, is double, is an improvement on the crank-lever and sheers, and decidedly superior to them; and the apparatus for elevating the tine-frame exhibits a fine mechanical taste, though the application and arrangement of the screw, the wheel and axle, and the levers to effect the purpose, is perhaps an example of too much elaboration for the particular case; yet, on the whole, it has all the requisites of a very perfect implement, and the only *objections* that appear against it are an excessive weight (the implement being constructed chiefly of cast-iron), and from this last circumstance, coupled with the elaborate mode of construction, a price that renders its introduction into Scotch farming a matter of considerable doubt. But a study of this implement by Scotch implement-makers, may be the means of producing improvements in the grubbers already described, for they are yet susceptible of such, and in no point more than in their height above the surface of the ground. Under those considerations, a figure of the Ducie cultivator is here annexed.

Fig. 416.



THE DUCIE CULTIVATOR.

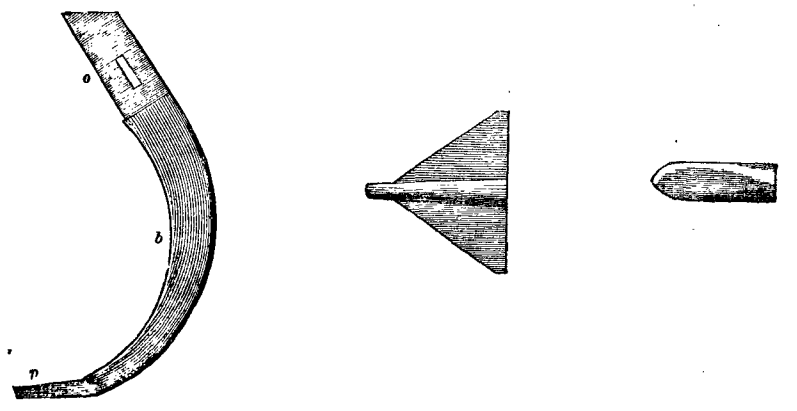
(2446.) Fig. 416 is a view in perspective of this implement. It consists of a frame *a a* of cast-iron, of an irregular pentagonal shape, formed in one entire casting; the outline of the frame resembling closely that of Finlayson's grubber, but its interior upfitting is entirely different. This frame carries five tines *b b*, &c., with which the machine is armed, and these are secured in the frame by means of tenon and key, in the manner of Kirkwood's (2440.). The frame thus constructed is mounted on two wheels *d d*, 3 feet 2 inches in diameter, which supports the body of the tine-frame; and the front or apex of the frame is

supported on the double castor-wheels *e e*, which are 18 inches in diameter. The wheels *d d* run upon a crank-pin fixed in the extremity of the crank *f* of the main axle, the latter having its bearings on the lower side of the tine-frame; in which last respect the axle differs only from that of Finlayson's grubber. On the main axle there is fitted a wheel, or segment of a wheel, having oblique teeth adapted to work in the endless screw or worm *l*, and the axle of the screw carries the winch-handle *m*. The oblique toothed wheel carries also a crank-pin, forming a lever, which is placed diametrically opposite to, and of equal radius with, the cranks *f* of the main axle, each being 6 inches. The front wheels are mounted on a reversed T-form axle, to the stem of which, marked *h*, the draught-shackle *g* is applied in a permanent position, so that the shackle and stem shall turn together, and, by consequence, the wheels also, forming thus a castor-wheel of the most perfect description. The stem *h* of this axle passes also vertically through an eye in the anterior angle of the tine-frame, the stem fitting the eye with tolerable exactness, but moving freely through it. The elevating and depressing of the tine-frame is accomplished by a very beautiful combination of parts. The lever *i i*, of equal arms, is connected at one end to the head of the stem *h*, by a slip-joint, which forms its fulcrum, and is therefore a lever of the second order; the point of resistance is in the head of the slender pillar *k*; which is fixed in the tine-frame at or near its centre of gravity, and to the head of this pillar the lever is jointed. The power end of the lever is also jointed to the head of the connecting-rod *n*, and the lower end of this rod is again jointed to the crank-pin of the oblique-toothed wheel which completes the elevating apparatus. When the tine-frame is to be raised, the winch-handle *m* is turned until, by a sufficient number of revolutions of the screw *l*, the toothed wheel, with its axle and cranks, has performed about one-third of a revolution; and thus, while the hind-part of the tine-frame is being elevated by the axle turning upon the crank-pins which carries the large wheels, the reverse or ascending motion of the pin in the toothed-wheel pushes up the connecting-rod *n*, and with it the end of the lever *i i*; but as this end of the lever, while it is elevated by the connecting-rod on the crank-pin of the toothed-wheel through a space equal to that which the opposite crank *f* elevates the tine-frame, the whole combination of the hind-axle is raised through an equal space; thus, if the tine-frame rises 6 inches, the connecting-rod *n*, in common with the frame, rises also 6 inches; but the connecting-rod, by means of the motion derived from its connection with the pin of the screw-wheel, is raised through an additional space of 6 inches, or in all 12 inches, and consequently, the end, *i n* of the lever, rises 12 inches also; and as the point *d*, where the lever is jointed to the pillar *k*, divides the lever into two equal parts, and the fulcrum in *h* being a fixed point, it follows that *d* will rise through half the space that the end *i n* has done, or 6 inches, and will lift up the fore-parts of the frame with it, sliding upon the stem *h*, and carrying the draught-shackle along with it. By reversing the motion of the winch-handle *m* the frame is lowered, and these movements will be made with perfect accuracy, preserving to the tine-frame a perfectly horizontal position at any height within the range of its lift. An index is attached to the main axle as seen at *p*, which is divided in the proportion of inches in depth of the penetration of the tines; but this is one of its least important points.

(2447.) Fig. 417 shews the form and the working position of one of the tines, *b* the body of the tine, *o* the tenon which enters the slot of the frame, where it is secured by a cutter passing through both, in the position of the slit in the tenon,

drawing it firmly into the slot, and *p* is the point of the tine adapted to receive the different forms of share with which the machine is furnished. Fig.

Fig. 417. Fig. 418. Fig. 419.



THE TINE AND SOCKS OF THE DUCIE CULTIVATOR.

418 is the upper surface of the webbed share that fits upon the point *p* of the tine, and is used for cutting the land clean below. Fig. 419 is a chisel-share used only when the land is hard and dry.

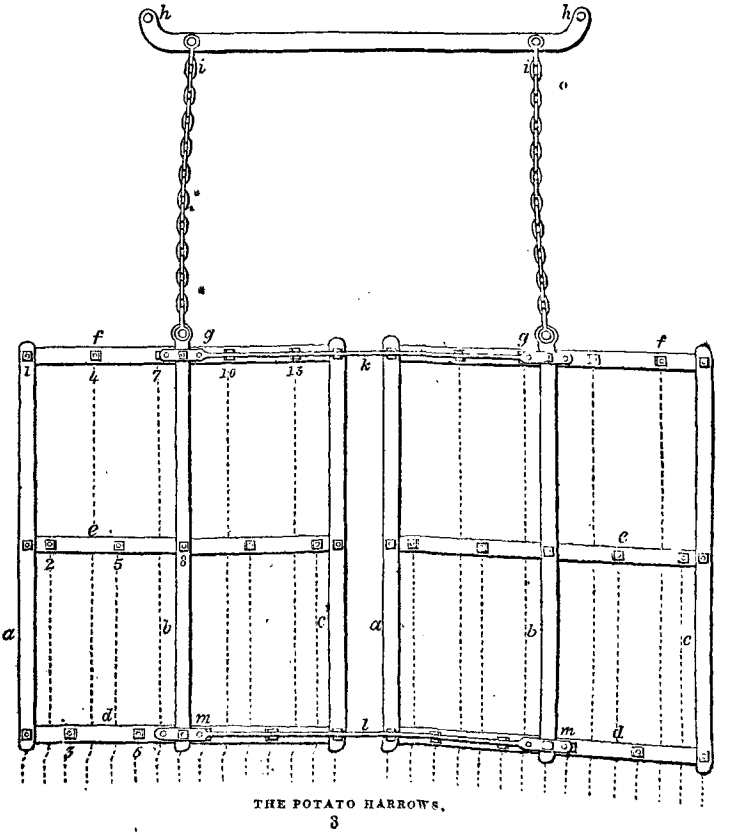
(2448.) Comparing the three varieties of the grubber here described, there are some points of strong resemblance, while there are others in which considerable difference exists. In all the modern Scotch grubbers the material of which they are fabricated is malleable iron, the wheels excepted; and as they are generally set on wheels not exceeding 20 or 22 inches diameter, the tine-frame is necessarily near the ground when in work, the distance being only a few inches. Wilkie's grubber is an exception to this, the hind-wheels being about three feet diameter. The depth to which these grubbers penetrate the soil varies from 5 to 8 inches, and the number of tines 5 or 7. The five-tined implements weigh from 3½ to 4 cwt., and the seven-tined 5 to 5½ cwt; the former is drawn by 2 or 3 horses, the latter never by less than 4 horses. The prices range from L.7 to L.10. Wilkie's, which is the most elaborately finished of any of the Scotch grubbers, can hardly be procured under L.12. Of the English grubbers or cultivators, the Ducies and Biddels seem to take the highest rank, the former, as just described, is almost entirely of cast-iron, and that of Biddels falls under the same description; they are, therefore, necessarily of greater weight than those of malleable iron, but they possess one advantage, that of greater height, and consequently, less liable to choke with weeds and roots. The weight of the cast-iron grubbers may be averaged at 10 cwt., and their price at L.15.

(2449.) *The Drill-Harrow* is another implement of recent introduction; like the other members of its tribe, it is of extremely simple construction, and from its having been first applied to potato-culture, it is frequently styled the *potato-harrow*. This harrow is always worked in pairs; and to render it applicable to its intended purpose, it is made of an arch form, partially embracing the curvature of the ridglet or drill. The two leaves of the pair are connected by

two coupling rods, which are formed to expand or contract to any required width of drills; and each leaf is furnished with a chain, to which a draught-bar or swing-tree is attached, and to which again the horse is yoked; the bar and chains, in this mode of yoking, serve by their weight to produce such a catanarian curvature as to make the vertical line of traction leave the harrows nearly in a horizontal line, giving them thus the full effect on the drill. Simple though the construction of this implement be, I frequently see a malformation in the placement of its tines; its breadth does not exceed 26 inches, and, therefore, the number of its tines need not exceed 18, though a streak at every $1\frac{3}{4}$ inch should be required; notwithstanding this, we frequently see these harrows with as many as 24 tines, and with such a number, unless a very careful division is made in their placement, many of them will follow in the track of others, and are hence of no use. In laying out this simple harrow, if the rule laid down in (2233.), as applicable to all harrows, is attended to, such useless waste of labour and materials might be saved, and the work for which the implement is intended will be equally well done.

(2450.) Fig. 420 is a geometrical plan of a pair of the rectangular drill-

Fig. 420.



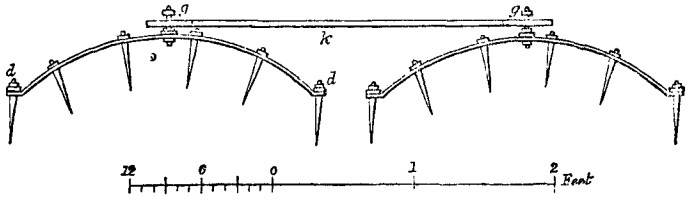
THE POTATO HARROWS.

3

harrows, in which a regular division of the tines is observed, and as the harrows are 26 inches from centre to centre of the outside bars or bulls, and the number of tines 15, they will draw streaks on the surface at equal distances of $1\frac{7}{8}$ inch nearly: the three bulls *a b c*, and the three cross-bars *d e f*, form the body of the harrow; the breadth over all is 27 inches, and the length 33 inches; the bulls and bars are all $1\frac{1}{4}$ by $\frac{3}{8}$ inch. There is no slotting, as in the common harrow, but the bulls and bars are simply crossed, and secured by a small bolt and nut, or they may be riveted together, except where a tine falls in the crossing, when it is secured by the nut of the tine itself. The bulls and cross-bars are simply punched for the tines, which are each secured by a screw-nut. The middle bull of each harrow is prolonged a little forward at *g*, and punched for the shackle of the draught-chain, which is affixed thereto by a bolt. The bolt which joins it to the cross-bar at each end is also prolonged upward 4 inches, having a collar above and nut below, forming a firm stud, on which the stretcher is placed, and retained by a nut above. The tines are about 4 inches in length below the bars, and are $\frac{5}{8}$ inch square at the shoulder, tapering to a blunt point.

(2451.) Fig. 421 is a cross section, at the front-bar, of both the leaves of the harrow, shewing the arched form and direction of the tines. The rise of

Fig. 421.



THE SECTION OF THE POTATO HARROWS.

the arch is 5 inches, but this may be varied, and if the arching is flat, the tines towards the apex should be shorter than those towards the sides of the harrow, to prevent injury to the young plants. In the front-bar the right hand tine may be left out, as its place may be taken up by that of the third bar, leaving 5 tines. In the second cross-bar there are also 5 tines, and in the third, 5. The two leaves are connected and kept at due distance by the coupling-rods *k*, which are $\frac{5}{8}$ inch diameter, and flattened at the ends to the extent of 5 inches, and have 3 perforations made at each end, at $1\frac{1}{2}$ inch pitch, or closer if thought necessary; this construction of the coupling-rods affords the means of adapting the harrows to any width of drills. The draught-chains *i i*, fig. 420, are about 2 feet long, and are shackled to the draught-bar, to which the horse is yoked by the eyes at *h h*. The pair of harrows are drawn by one horse, walking between the drills; the weight of the pair, with the mounting, is about 90 lb., and the price from 30s. to 35s. complete.

(2452.) *Triangular Drill-Harrows* are considered by some agriculturists as superior in effect to the rectangular form; with due attention to the division and placement of the tines, they may no doubt be rendered equally effective, and probably more so, but the advantages are not permanently marked.

(2453.) On farms where potatoes are raised only to supply the wants of the

people who labour them, the drills may be made in the single or double way, as may suit the fancy of the farmer, but he should bear in mind, that the more minutely the soil is pulverized, the better state it will be in for the crop. But where potatoes are raised for the London or the markets of other great towns, a mode of culture should be adopted to admit of much work being done in the limited period in which potatoes should be planted. Bearing this necessity in view, the land should be drilled up in the single mode in preparation for the dung, the dung then spread in the manner represented in fig. 411, and the drills split with a double mould-board plough; but as it is desirable that the earth in the drills should be as lightly put over the sets as possible, and as the common mould-board plough presses very much upon the lower part of the sides of the drills, the under part of the hind-end of the mould-board should be cut away, and the plough otherwise formed, that is, of such size and length, as to be worked by a pair of horses instead of one. The double mould-board, besides affording expedition, covers the dung equally with both furrows, puts less earth over the sets, permits the germs to grow upright at once, and thereby allows the access of more air to the sets. Still it will be requisite to harrow down the drills before the sets send up their germs to the surface of the ground.

(2454.) Being desirous of ascertaining the true cause of the failure in potatoes, I am ready to recommend to your notice every rational explanation that is offered on the subject. The following explanation is, I believe, from the pen of Professor Lindley of London, and therefore deserves attention. At the same time, I must own, that the explanation is unsatisfactory to me, inasmuch as the tubers in the soil, in regard to their liability of being acted on by chemical agencies, would be the same many years ago, when failure was not so universal, as it has been within these few years. "The potato crop," he says, "has of late years been seriously affected by a disease which consists in the production of tubers, instead of stems, when growth first commences after planting, and in the loss of all further power of vegetation consequent upon this malformation. We have examined several specimens of the disease without succeeding in discovering the smallest trace of organic injury, and we feel satisfied that there is nothing in the visible formation of the potato which will account for it. All the tubers, young and old, seem perfect. It is therefore probable that chemistry must be called upon to explain the source of the mischief, and that some deficiency or excess of the proximate principles lodged in the tuber will be found connected with it. Although we have nothing positive to state in confirmation of this suggestion, yet there are some facts which may possibly lead to the discovery. We all know that the potato-shoots, when first produced, are fed by the matter lodged in the tuber from which the shoots proceed. That matter consists largely of starch,—an insoluble substance, which only becomes capable of nourishing a young shoot by changing into gum or sugar. Chemists tell us that such change is effected by a form of matter which they name Diastase, in which nitrogen is an element. Since we know that the quantity of azotized matter found in a potato varies very considerably, it is probable that the quantity of diastase also varies, and that in some cases it may be altogether insufficient to render the starch soluble, except to a small extent. If that were so, the bud, when it springs from a tuber, would be unable to grow into a shoot bearing leaves, but would develop itself in an imperfect way, and remain as a little tuber, without any power of growing further. This *may* be the history of the disease in the potato now under consideration; and if so, it would perhaps be removed by add-

ing azotized manure; for the latter, when decomposing in the soil, may furnish the nitrogen that is required. It is true that diastase is a peculiar compound, and that we have no authority for supposing diastase itself likely to be formed in a potato by the addition of azotized matter to soil. On the other hand, we know so little of nitrogen, and its action in vegetation, except that its influence is most important, that it is a fair subject of speculation. If leaves cannot decompose carbonic acid, except in the presence of nitrogen, it may very well be that starch also cannot change into sugar or gum except in its presence, and that in any nascent state it may act just as well as if produced by the decomposition of diastase. We would recommend, then, those whose potatoes are thus affected to manure them at once with water containing ammonia. This can do no harm, and may do good. Experiment, too, is somewhat favourable to the trial; for lately, in the garden of the Horticultural Society, some potatoes which had not made their appearance above ground at the time when others, planted at the same period, were in full vegetation, were, at the desire of Mr Edward Solly, watered with a weak solution of muriate of ammonia; when in a few days the leaves and stems came up, and are now the most vigorous of all."* This last recommendation, of course, can only be practised in garden culture.

---

58. OF BREAKING IN YOUNG DRAUGHT-HORSES.

"Thy flattering method with the youth pursue;
Joined with his school-fellows, by two and two,
Persuade 'em first to lead an empty wheel,
That scarce the dust can raise, or they can feel;
In length of time produce the lab'ring yoke
And shining shares, that make the furrow smoke."

DRYDEN'S VIRGIL.

(2455.) Young draught-horses are never *broke in*. They are most frequently yoked with an old steady horse at once into the harrows, accompanied with a few restrainers of reins and ropes, or an additional hand or two to assist the ploughman, to prevent any attempt at a run away; and, no doubt, when colts have been haltered and led about from the time they were weaned by a steady quiet-tempered man, they will soon submit to work, and become harmless in the course of a few short yokings. But, notwithstanding their quietness, they cannot be said to be *broke in*, in the proper sense of the term, that is, they do not yield to the guidance of the ploughman, because they either know or understand what he means, or would subject themselves to his control, but because they feel they are subdued, and are obliged to move along with an

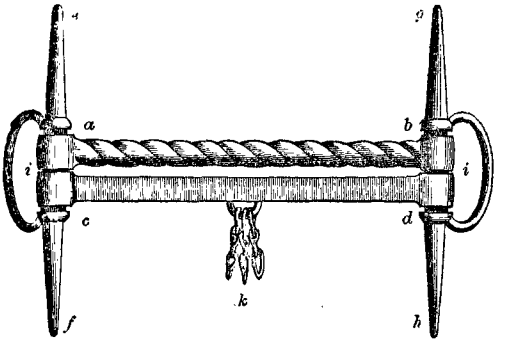
* The Gardeners' Chronicle for June 24. 1843.

older and stronger horse, to which they are attached, as he may choose to lead them. Their mouth is quite intractable to the bit all the time they are apparently subdued; they seize the bit with their teeth, and press upon it, with their head hanging down, their neck arched, and their eyes set back, as if suspicious of harm overtaking them. In this way, day after day, or at least in every yoking they are worked, they look liker objects of oppression and pity, than of pride to the farmer, on seeing the young and noble steed he has bred and reared first undertake its work. The rein may be pulled this way and that to no purpose; and in the end the dull sulky-looking colt is confirmed in his natural temper, and the timid one rendered more afraid. No doubt time, in this as in every other thing, brings about a change; but why should the change, even for the better, be allowed to be effected by lapse of time, to the discomfort and annoyance of the animal in the mean time, when he can be broke in to his work with comparative ease? "Aye, break him in indeed, but remember the cost," is the ready rejoinder to the question just asked; and the answer to the rejoinder is as ready, What although it does cost some money to break in a colt to do his work in a proper manner, in the most easy way for himself, and in the shortest time to his master? Is a little cost to be put in comparison to giving trouble to people to teach a colt how to perform his work, who know nothing of the rules of tuition, and who therefore run the risk of spoiling the colt for life? Is one guinea such a deadly sum as to induce any owner of a fine colt to run the risk of spoiling him—for no greater cost need be incurred in breaking in a draught-colt to his work.

(2456.) The easiest plan to make a draught-colt work well soon, is to employ a good horse-breaker to bridle, and handle, and lunge him for a short time—as long as is requisite to make his mouth yield to the bit—and then he will obey both voice and rein; and while employing the rein, the horse-breaker should be instructed to use the language that will be spoken to him while at work, the terms of which I have fully explained in (1120.). The harness required for this purpose is a breaking-bridle, a cavesson, and pad for the back, all of which the horse-breaker will supply. I must remark, however, that most of the bits I have seen used in breaking-bridles seem to me inefficient for the purpose. They are very thick at the guard, round, and jointed in the middle, a construction which gives the horse an opportunity of seizing the round thick part with his grinders, when folded back by the force of the rein acting on the joint, and of resting his head upon it. A more efficient bit is represented in fig. 422, which I have seen used many years ago in Berwickshire, by

Thomas Middlemiss of Norham, who was reckoned in his day one of the best horse-breakers and grooms that had practised in that part of the

Fig. 422.



THE BREAKING-BRIDLE BIT.

country. It consists of two bits, one twisted and the other square, both 8½ inches in length. The square bit *c d* is ½ an inch square, and so is the diameter of the twisted one *a b*, and they both have a play of ½ an inch between the shoulders of the guards *a c* and *b d*. The guards *e f*, *g h*, are 7 inches in length. The ring *i* on each side is 2½ inches in diameter over all, and at *k* is a bunch of links to play upon the tongue, and make the horse move his jaws. The straps connected with the bit are, first, the *head-stool;* the *hand-reins*, 4½ feet in length; the *cheek-reins* to keep the horse's head in line, when strapped to the pad, and which pass *below* the neck-strap of the martingale. All these 3 straps are buckled to the rings *i i*. There is, besides, a *martingale* to prevent the head being thrown forcibly up. The breadth of the straps is 1 inch; that of the counter-strap of the martingale 1½ inch. The bit can be buckled on in the reverse order shewn in the cut, having the square bit *c d* uppermost, and the bunch *k* is then screwed to the twisted bit *a b*. The cavesson is well known, and requires no particular description, its figure and appointments being uniformly the same.

(2457.) It is unnecessary to go through all the discipline of breaking in a draught-colt, as is required in the case of a saddle-horse, but a few preliminary steps are necessary, such as playing the bit in the mouth for 2 or 3 hours in the stable, twice or thrice a-day, the colt standing in the reversed position in the stall, which has the double advantage of making the mouth yield to the bit, and of keeping up the horse's head. The bit is buckled on slack for this purpose, so as to lie upon the gums, on

the bare space of the lower jaws between the front and back teeth, upon which place either the square or twisted bit is felt to rub sharply, while the bunch of links *k* makes the mouth and tongue play as if desirous of getting quit of the whole concern. When the head is pressed forward to get hold of the bit with the back teeth, the straps being too long, the head finds nothing to *rest* upon, while the bunch *k* is brought too far back upon the tongue to be agreeable. After this discipline in the stable for two or three days, according as it is seen that the colt yields to the bit, with occasional walks out of the stable, he should be led out to *walk* two or three hours at a time by the nose-rein of the cavesson, to learn to step out, and to acquire a good pace; and this is the most essential discipline for a draught-horse. A short lunge or two backwards and forwards round a circle, on red land, will be useful, not to teach him to trot; but the trotting exercise will make him active, and sooner get the use of his legs in cases of difficulty. He should then be backed, and, while guided by the reins, should be spoken to in the language he will be addressed in the yoke. After that he should be guided along a road with long double-reins, while carrying the plough chains to accustom him to their noise and feel, and addressed in the appropriate language. Now all this discipline may be gone through in the course of a week, or 8 or 10 days, according to the disposition of the animal, the handling he may have received since he was a weaned foal, and the genius of the horse-breaker. The horse-breaker should groom the colt immediately after exercise, that the animal may become familiarized with the usages of the stable, and the degree of exercise given should be with a discrimination suited to the condition and physical strength of the animal. The colt's food, too, should be so administered as to harden his condition for labour, with the understanding, however, that, after the busy season of work is finished in the early part of summer, the young tyro shall be allowed to have a run at grass for a few weeks, and then fall into his own share of regular work.

(2458.) After the treatment and discipline received from the horse-breaker, the colt will be easily made to understand work. The sort of harness with which he is first invested is that of the plough, consisting of a bridle, collar, fig. 197, and back-band and chains, or *theats*, as these are called in some parts of the country. It is quite possible, that the discipline received from the horse-breaker, will make the colt suffer at once to be yoked with an old horse at the plough; but in case of accidents, and to err on the safe side, it is best to use precaution, even though it should be proved to have been unnecessary. The principal precaution

is to attach the colt to a strong steady horse, that will neither bite nor kick him, and be able to withstand the plunges the colt may choose to make. The attachment is made by a cart-rope being first fastened round the girth of the old horse, and then passed round that of the colt, leaving as little space between their bodies as is required for ploughing; and to afford no liberty to advance or retire beyond a step or two before or behind the old horse. Beside the usual rein employed by the ploughman, the horse-breaker should have another in his hand from the colt's head. Thus equipped in plough-harness, the first yoking of the colt should be to an old cart-wheel, placed on its dished face on ploughed land, furnished with a swing-tree, which he should be made to draw, while the horse walks beside him; and in drawing this, the reins should be used, and the appropriate language spoken, that he may associate the changes of his motions with the accompanying sounds, and which are indicated by the reins while guiding him. I remark in passing, how curious it is for us to have adopted the Roman method of breaking young horses by the employment of the wheel, as set forth in the motto selected from Virgil. Should the colt offer to wheel round, the gentlest means should be used in putting him again in his proper position, as the start may have been made from fear, or from the tickling of a part of the harness. When a hind-leg gets over a trace chain, the chain should be unhooked from the swing-tree, and hooked on again after the colt has been put in his right position. Should he offer to rear or kick, from a disposition to break away, the old horse should be urged on to the walk, and be made to pull him along, while a smart tip of the whip will take the courage out of him. According as he evinces a disposition to go on quietly in the work, should the length of time be determined at which he should work at the wheel. When submissive, he should be yoked to the plough, for there is no species of work which calls forth the sympathy of horses to one another in so short a time as when working with this implement; and after a few landings, it will be seen that he will work with energy and good-will, and then he should be kindly spoken to, encouraged, and even fondled. The probability is, that his desire for the draught may be evinced too keenly, but the pace of the old horse should be subdued, and the keenness mitigated by the rein and *tug*, which the short reins are called, that pass from the head of one horse to the collar of the other, and which, in this particular instance, is fastened to the rope round the girth of the old horse. It is interesting to the farmer to see his young horse put his shoulder to the first work he has ever tried with a spirit even beyond his strength; and while he continues at the work until his nostrils distend and flanks heave, his owner

cannot help having a regard for him, heightened by a feeling of pity for the unconscious creature acquiring experience of work at which he is about to be doomed to toil for the remainder of his life. It should be mentioned as a precaution, that all the harness employed about the first yoking of a young horse should be fresh and strong, and not likely to break, even by violence. The colt should be broke in to the cart as well as the plough. He is yoked into a single horse-cart, but great care should be used on the first yoking, that he get no fright, by any strap rubbing against him, or the shafts falling upon him when raised up to allow of his being backed below them, for if frightened at the first yoking to a cart, a long time will elapse ere he will stand the yoking quietly. The horse-breaker should stand in the cart using double reins; and a rein should be held by a man walking first on each side of his head, and then at a little distance on the sides of the road. The chief danger is kicking, and thereby injuring the hocks against the front-bar of the cart, to prevent which a rope should be placed across the top of the colt's rump, and fastened to the harness on the rump, and on each side to the shaft of the cart. There is little danger of his running away while all the reins are good. He will take with the traces of the cart more readily at first than with the trams, as they are so similar to the yoking he has felt at the plough, and he is conscious of having his companion behind him.

(2459.) On the first use of harness by a young horse, the shoulders and back are liable to become inflamed, and even the skin to be broken by the collar and saddle. It should be ascertained, in the first place, that the collar he is to work in fits him properly; and if it does not, it should be made to do so, before he use it, as the first day's use may so injure his skin as to give him pain for weeks thereafter. The usual affection is heated swellings in the line of the collar and seat of the saddle. A good lotion to be applied to those parts whenever the colt comes out of yoke is a solution of common salt in warm water, and, when cold, applied as a fomentation with a sponge. The water not only cools the skin, and keeps down the inflammation, but the salt hardens it for use; and in the course of a short time, particularly if the weather be dry, the skin will become inured to the pressure of the harness. A young horse may be broke in for work any time in the course of the spring, from the beginning of working the turnip-land to its completion. I can affirm the efficiency of the plan I have recommended by repeated experience, and it is one unattended with the slightest accident in practising it.

(2460.) It is the usual practice to shoe and dock the young horse before putting him to the yoke. I think he should first be broke in, and then he will suffer himself to be shod the more quietly. At the *first shoeing* it will be useful, in making him stand quietly, and in diverting his attention, to take the old horse he has been working with to the smithy. By nailing a mat against the wall, and making him stand alongside the mat, it will save his skin being ruffled should he rub against the wall, whilst the wall will form a firm barrier against his retreating farther from the blacksmith. After the fore and hind feet of one side have been shod, these can next be turned to the wall to get his other feet shod. Gentle and coaxing means should be used, though a twitch on the nose has a powerful command over a horse. The first shoes of a young horse should be light, with no heels, and the hoofs should not be pared down much at first. Rather renew the shoes, and pare the hoofs down again in a short time, than encumber a colt at first with heavy shoes with heels, to the risk of trampling himself, as to cure the effects of a severe tramp may cost much more than the price of many sets of new shoes. As to *docking* a draught-horse, I think it a necessary operation, because a long rump is very apt to get injured when the horse is yoked in the trams, by coming against the body of the cart, and in coup-carts especially it can scarcely escape being nipped when the body of the cart is brought down upon it when lying on the front-bar, and besides a draught-horse has no use for a *long* tail. A neat swish is all that is requisite at any time, and in winter even that is apt to become loaded with mud on dirty roads. Some writers affect to believe it presumptuous in man to deprive any animal of 6 of the joints of the vertebral column which Nature has given him; and no doubt were our horses always idle, especially in summer, when a long tail is of essential service in whisking off flies, the vertebræ ought to be kept entire; but surely there is no greater absurdity in docking the tail, than in driving iron nails into the crust of the hoofs of a horse, and yet without iron shoes to protect it, the horny foot of the horse would be beaten to pieces on hard roads at the pace many kinds of horses are driven along them; and there is no necessary cruelty in the act of docking, for it is an operation of the simplest form when properly done, that is, when effected in a joint where the wound is easily healed. As to *nicking the tail* and *cropping the ears*, such operations are never performed on draught-horses, and at best only serve to disfigure the appearance of the animals subjected to such unnecessary torture.

59. OF SOWS FARROWING OR LITTERING.

"Sows ready to farrow this time of the year,
Are for to be made of, and counted full dear;
For now is the loss of a fare of the sow,
More great than the loss of two calves of the cow."
TUSSER.

(2461.) It should be so managed where there are more than one brood-sow on a farm, to have one to bring forth pigs early in spring; but, at the same time, it should be borne in mind, that young pigs are very susceptible of cold, and if exposed to it, though they may not actually die, their growth will be so stinted as to prevent them attaining to a large size, however fat they may be made. Even the most comfortable housing will not protect them from the influence of the external air, any more than certain constitutional temperaments can be rendered comfortable in any circumstance in spring, when under the influence of the east wind. From March to September may, perhaps, be considered as the period of the year when young pigs thrive best.

(2462.) Whenever a brood-sow shews symptoms of approaching parturition; that is, when the vulva is observed to enlarge and become red, it is time to prepare the sty for her reception, for she will keep her reckoning not only to a day but to an hour. The period of gestation of a sow is 112 days, or 16 weeks. The apartments meant to accommodate brood-sows in the steading are marked by the letter *c* in figs. 3 and 4, Plates III. and IV. They consist of an outer-court 18 feet long by 8 feet broad, enclosed by a door, as represented in fig. 23, and described at 5 in (68.), and an inner apartment 8 feet by 6, roofed in. This is the usual form of a sty for sows, but others more convenient for overlooking the state of the sow and her pigs is when the outer court and inner apartment are placed under one roof, that is, in a roofed shed, or in a house which may be shut in by a door. The litter allowed to a brood-sow should be rather scanty and of short texture, such as chaff, short straw, or dried leaves of trees, as young pigs are apt at first to be smothered or squeezed to death among long straw, when they get under it. When a sow has liberty before she is about to pig, she will carry straw in her mouth, and collect it in a heap in some retired corner of a shed, and bury herself amongst it, and the chance is, in such a case, that some of the pigs will be lain down upon unseen and smothered by the sow herself; when seen

she will carefully push them aside with her snout before lying down. Some sows have a trick of wandering away to litter in a quiet place, such as in a field of corn, in a plantation amongst underwood, or in a dry ditch at the root of an old hedge or tree. I remember of a sow being missing for upwards of a fortnight, not a person having seen her leave home, or being able to discover where she had gone to; but she was suspected of having disappeared for the purpose of littering. At length she appeared one day craving for food at the kitchen-door, bearing evident signs of having littered, and of having suckled pigs. She was cautiously tracked to her hiding-place, though jealous of being discovered; and it was found that she had formed a nest with the straw gathered from the adjoining field of wheat, in a secluded part of a dry ditch at the root of an old thorn-hedge, about 300 yards from the steading. She had subsisted as long as she could upon the corn, but hunger at length drove her to the house in search of food. Had she been allowed, she would, no doubt, have come to the house every day for food; but means, of course, were used to have the pigs conveyed to the steading, and this was a work of some difficulty, as the sow herself was perfectly savage when any one approached her young ones; and these were so wild in their habits, that they eluded capture for a long time among the standing corn. At length, by the assistance of the shepherd's dog, which seemed to enjoy the affair as sport, they were all caught, a large litter, and, on being conveyed home in a large basket, the sow naturally followed her captive young ones. I remember of another sow taking up her abode in the bottom of a pease-stack, where a small hole was only left as an entrance, but a large chamber was formed in the interior, and it was found impracticable to dislodge her from this stronghold, she keeping every man and the shepherd's dog at bay, and he was too knowing to venture to attack her in single combat; so she was let alone, and she produced her young there, and kept them until they were able to run about, food having been set down for her. I mention these instances of the peculiar habits of some domesticated sows, merely to shew you the propriety of securing the brood-sow that is about to farrow, and particularly one that is given to wander abroad in search of a nest, in a proper sty some time before the period of her reckoning.

(2463). Knowing the day of her reckoning, she should be attended to pretty frequently, not that she will probably require assistance in the act of parturition, like a cow or a ewe, but merely to see that all the pigs are safe, and to remove any one immediately that may be dead when pigged, or may have died in the pigging. I have heard, however, of a sow in high condition which died because the second pig, on com-

ing by the breech presentation, had a hind-leg folded back, which could not be put right by the sow herself in pressing, and having been neglected, her parts very much swelled. As an attempt to save her life, the Cesarian operation was performed on her, and the obstructing pig was removed; the animal lived, but the others in her womb were dead, and she herself did not survive the operation above an hour, having been completely exhausted before it was attempted. I do not know whether it is generally the case, but I have frequently observed that pigs leave the womb alternately in a reversed order; that is, they are projected by a head and breech presentation alternately, not uniformly so, but most frequently. There is no doubt, however, of the fact, that the first born pigs are the strongest, and the last the smallest and weakest, in a large litter, such as upwards of 12, though the difference is less or scarcely observable in smaller litters of 6 or 8. The small weak pigs are usually nicknamed *wrigs*, or *pock-shakings*, and are scarcely worth bringing up; still, if there is a teat for them to lay hold of, they ought not to be destroyed. Sometimes there are more pigs littered than the sow has teats to give to each. I have seen as many as 19 pigs when there were only 12 teats; and I remember of a sow that never littered fewer than 17 when she had 14 teats, which are two more than the usual number. Extra pigs can, no doubt, be brought up by hand on cow's milk, but the last ones of a very large litter are usually so small and weak that they generally die off in the course of a day or two to the number of the teats. A young pig soon gets to its feet after birth, and as soon finds its way to the teat; but it can find no sustenance from it until the sow pleases, so that until the entire parturition is accomplished and the sow recovered from it, there is no chance of the pigs getting a suck. Many sows are very sick during parturition, and for some time after; so much so that the skin of their mouth becomes bleached and parched, and the breathing quick. To those unaccustomed to see a sow in that state, it would seem that she must die; but a little rest recovers her, and she betakes herself fondly to her young. It is necessary, as I have said, to remove the pigs as they die, if any die, as some sows evince the abominable propensity of eating their own pigs when they die, whether the death takes place at the birth, or immediately after, or whether it happens on their being smothered or squeezed to death by being lain down upon by the sow herself, when nestled between her and the wall. I remember of a sow that was never sick at pigging, and such was her propensity to eat every pig that died or was smothered, that even during parturition she would get up as every pig was born, to ascertain whether it was dead or alive, and, if dead, would eat it instantly, provided she was not pre-

vented; and even after they were a week old she would eat them, had they died by accident. There is a peculiarity exhibited by young pigs, different from the young of other domesticated animals, in each choosing a teat for itself, and ever after keeping possession of it; and this compact, as it were, is faithfully maintained. Should there be one pig more than there are teats, it must take its chance of obtaining a teat when the rest are satisfied. It is generally observed that the pigs which are supported at the foremost teats become the strongest; and the fact was noticed long ago by Tusser, who recommends store pigs to be those which are

> "Ungelt, of the *best* keep a couple for store,
> One boar pig and sow pig, that *sucketh before*."

Pigs require to use coaxing before the sow will give them milk. They make loud entreaties, and rub the udder with their noses to induce her to lie down, which, when she does, every pig takes its own place right earnestly, and nuzzles away at the udder with the teat held in the mouth, whether situate in the upper or lower row. After a good while of this sort of preparation, the milk begins to flow on the sow emitting a fond-like grunting sound, during which the milk is drawn steadily and quietly till the pigs are all satisfied, and they not unfrequently fall fast asleep with the teat in the mouth. Young pigs are lively happy creatures, and fond of play as long as they are awake, but they are great sleepers. When a week old, their skins are clean, hair soft and silky, and with plump bodies and bright eyes, there are few more beautiful young animals to be seen about a farm-yard. Those of a white colour look the most delicate and fine.

(2464.) As to the *food of the sow* after she has recovered from parturition, which will be longer or shorter according to her constitutional temperament, she should get a warm drink, consisting of thinnish gruel of oatmeal and luke-warm water, and which serves the double purpose of meat and drink. If she is thirsty, which she is likely to be on recovery from sickness, the gruel may be again offered in a thinner state in an hour or two afterwards. The ordinary food may consist of boiled potatoes, with a mixture of barleymeal, amongst water, administered at a stated hour at morning, noon, and night, with such refuse as may occur from the farm-house. This food will be found to support her well while nursing; and it should be borne in mind, that as long as she is nursing she should receive abundance of food if it is desired she should rear *good* pigs. Should the weather be frosty, or otherwise cold, the water may be given a little warmed, but in fresh weather, or in summer, cold water is most acceptable to her. The mess should not be made so thin as to

be sloppy and take a long time to drink up, or so thick as to be cloggy in the mouth, but in a state of gruel, meat and drink at the same time. Whatever food is given to her should be *cooked*, and not in a raw state, that is to say, the potatoes should be *boiled* and not given raw, and the barleymeal should first be made into brose with warm water, and then mixed with the potatoes, and the whole mess made like gruel with cold water. The trough out of which she receives her food should be washed every two or three days in cold, and every day in warm weather. I believe it is the common practice never to give pigs salt amongst their food, because it is said to encourage the *scab*. A large quantity of salt may have this effect, but I never saw a relish of salt produce such an effect. When a sow leaves any of the food in the trough it should not be presented to *her* again, but given to the young pigs, who will relish it.

(2465.) Most pigs are usually gelded, both male and female, the few that are kept for breeding forming but a small exception. They should be gelded on the milk at from 10 to 14 days old. The males are castrated on being held between the knees, and the scrotum incised down upon each testicle, which is removed by the pressure of the finger and thumb, and the spermatic chord separated by the knife. The she-pigs are treated in a different manner. Being laid on a chair bottom or table, on its far side, the pig is there held by an assistant; the operator cuts an upright incision into the flank, of about 2 inches in length, and introducing a finger, brings out the ovaria of the womb, and separates them by the knife. He then closes the incision by a few stitches with a needle and thread, and the operation is finished. There is very little danger attending the operation to either sex. In the case of rupture or hernia in the male—and some breeds of pigs are very liable to this disease when young—it is necessary to stitch up the incision of the scrotum, and the testicle at castration should, in such a case, be removed with care, in case of producing inflammation in the intestines. The incisions in both the male and female generally heal by the first intention. The gelder should use the precaution of cleaning his knife before every operation. The usual charge for gelding pigs is 2s. 6d. the litter, whatever number it may contain. Young pigs are not gelded when intended to be killed for roasting.

(2466.) It is seldom that any complaint overtakes the sow on littering, though she may be carried off by puerperal fever, and I suspect there is no remedy for this disease in her case. The pigs which she leaves may be very well brought up by hand on cow's milk, as they will soon learn to drink out of a dish, in which the milk should be given

them warm from the cow, and as often as the cows are milked. It is surprising how small a quantity of milk a pig will drink at a time; and on this account they should get it frequently, and the dish in which it is served should not be easily upset, because there will be a struggle to get first at the milk, and one or more will be sure to jump into it. The diseases incidental to young pigs are luckily few. Their tails sometimes drop off with a sort of canker; and a red eruption sometimes takes place on their skin; and sometimes one in a litter may take a wasting and die. I believe that if the sow is provided with plenty of wholesome food, the pigs kept clean and warm in their sty and litter, and their sire and dam be not too near a-kin, that few diseases will overtake pigs as long as they are on their mother's milk. A sow is not allowed to take the boar until after the pigs are weaned, but as soon after as possible, in a week or two; and to bring her into season the sooner, she should be fed with oats or oat-meal until she takes the boar. The symptoms of season in a sow are a redness and enlargement of the vulva, which, when observed, the boar should have access to her; and should there be a boar on the spot, the meeting will be easily accomplished, and one embrace, which is usually a protracted one, is quite sufficient for securing a litter of pigs. When there is no boar on the farm, the sow is sent to him, and she remains a few days with him to secure her impregnation. Pigs are weaned at 6 weeks old, and some keep them on the sow for 2 months; but there is little thrift in such management, as the suckling in the last week of a large litter of large pigs brings a sow very fast down in condition, and which must be made up again with extra feeding and a longer time before she farrows the next time. A sow that can bring up 10 pigs, and has 5 such litters in the course of 2 years, is a profitable animal, and deserves to be well maintained and taken care of. Even at 10s. a-piece, which is the lowest sum a farmer should take for a pig, for he should keep it until it is worth that sum rather than part with it at a lower one, such a sow will return L.25 in the course of 2 years.

(2467.) As it is considered by farmers inconvenient to keep beyond a certain number of pigs on the farm-stead, it is necessary to determine what that number should be, and as it is difficult to fix its amount for every particular case, a few hints on different modes of managing litters, after they are weaned, may prove acceptable to you. Before investigating this point, a few particulars may be stated which you may regard in the light of *maxims* on this subject. A sow should always be either with young or giving suck, for if allowed to run about in season, or *a-breaming*, as it is termed, she will lose flesh instead of gaining it. A sow should always be kept in good condition, whether with young or supporting young, because a lean sow never brings forth or can nourish strong pigs. Every breeder and feeder of pigs will find his own advantage in never allowing them to go to bed with a hungry belly. A sow that brings forth the greatest

number of pigs of the best quality, proves the best nurse, and is most careful of her young, should always be preferred as a brood-sow. When a sow gets old, she is apt to become careless of her pigs, so that 3 or 4 years may be age enough for a brood-sow. Pigs, though on grass during the day in summer, should, nevertheless, receive a drink of water and meal, or potatoes, or of whey at morning and evening.

(2468.) There are just two ways of rearing pigs on a farm, one is to have a large number of sows, and sell the pigs when they are weaned at 6 weeks old; the other is, to have fewer sows, and rear the pigs until they are fit for the pork-curers; and the adoption of either of these plans depends entirely on the nature of the market of the locality. If there is a demand for young pigs immediately after being weaned, supporting the larger number of sows will be the most profitable plan for the farmer, because the pigs have not to be maintained on food independently of their mothers; but it is a plan attended with much trouble, inasmuch as food has to be daily cooked for the sows while supporting their young, and the market for pigs is, moreover, confined to one age. In the latter plan, on the other hand, the sows are only supported on special food as long as they support the pigs, and there is not only the choice of the market for newly weaned pigs, but for pigs of various ages, suited to the tastes of pork-curers. Suppose, then, that 2 sows are maintained, in pursuance of the latter plan, and that they bring forth 20 pigs twice a-year. Retaining 4 of these for ham, and other 2 for pickled pork, for the use of the house, there will be 34 pigs to dispose of every year, and as these meet with a ready market when 4 or 5 stones imperial each, at 6s. a-stone, will make them worth each from 24s. to 30s., or from L.40 to L.50 a-year for pigs. It should be borne in mind that these 34 pigs, when running about the courts in winter, eating a few turnips or potatoes, or grazing in the grass-field in summer, do not cost much to rear them to the weight most desiderated by the curers of pork, and they are in that state fat enough for the purpose, and make very wholesome meat. On a farm of 500 acres, 2 brood-sows could thus be easily maintained, on a larger farm 3 might be kept, and on a smaller 1 may suffice; but circumstances must regulate the proper number. Where dairy-husbandry is more attended to on one farm than on another, and when the mixed husbandry is practised on both, more sows may easily be kept in summer than where the dairy-husbandry is less attended to. There is a remark of Mr Henderson on this subject, which is worthy of attention, in regard to the timing of sows in bearing their litters of pigs. "Whenever," he says, "farmers have an opportunity of selling pork at all seasons, they do not think it necessary to make the sows bring their litters at a particular season, as they wish to have a lot of a certain age to go off regularly at least every month," in autumn, winter, and spring. "They make them ready for the market," he continues, "with little expense, only giving them close feeding 2 or 3 weeks previous to their being sold." Pigs intended for pickled pork merely, do not require even this feeding, though those sold for making hams are the better for a little extra and hardening feeding. "They have very little trouble in selling them," concludes Mr Henderson, "as there are jobbers continually travelling through the country, purchasing swine of all descriptions, who receive them and pay the money at the farms."

(2469.) The omnivorous disposition of swine is well known, and it is this disposition which makes them so easily maintained, and so serviceable on a farm. "Swine, though exceedingly voracious," remarks Mr Henderson, "will feed al-

most on any thing. In miry and marshy ground they devour worms, frogs, fern, rush, and hedge-roots. In drier and woody countries, they feed on haws, sloes, crabs, mast, chestnuts, acorns, &c., and on this food they will grow fleshy and fat. They are a kind of natural scavengers; will thrive on the trash of an orchard, the outcasts of the kitchen, the sweepings of barns and granaries, the offals of a market, and most richly on the refuse of a dairy. If near the sea they will search the shores for shell-fish, in the fields they eat grass, and in great towns they are supported chiefly by grains. It is evident that the facility of feeding them everywhere at a small expense, is a material benefit, more especially in a country where people are accustomed to eat flesh daily, or, on the other hand, where there is so ready a market for bacon and pork as we have. It is no less observable, that, notwithstanding the facility of feeding, and the multitude of swine maintained, they seldom fail of coming to a good market. Swine ought to have hard feeding two or three weeks previous to their being killed, to give firmness to the flesh. This practice ought to be particularly attended to by those who feed at distilleries on burnt ale and grains, as the fat of pigs thus fed melts almost wholly away in boiling or roasting; pease and beans are excellent for the purpose, and acorns are still better. Where oak plantations are near, they will resort to them in autumn, and there remain until this their favourite food is exhausted. The late Sir James Colquhoun of Luss, I have been told, was in the habit of sending his pigs to one of the islands of Loch Lomond, where there is an oak plantation, that they might pick up the acorns, which is said to have given a surprising degree of delicacy to the flesh. Those who have woods of this kind, and orchards, ought to allow their pigs liberty to range among the trees, to pick up shaken fruit and seeds."* The hogs of Germany enjoy the droppings of the oak and chestnut forests, and it is supposed that it is this species of food that imparts the very superior flavour which the hams of Westphalia are known to possess. That all the hams sold in this country for Westphalian are genuine, I have doubts, after having become acquainted with the true flavour in their own country. I remember of passing through a forest of sweet chestnuts of, I dare say, 3 miles in length, near Bellinzona, in the canton of Ticino, in Switzerland, in autumn, when the fruit was dropping from the trees; and into this forest the peasantry, I was informed, turned their pigs every year to get fattened at the season I allude to.

(2470.) Swine should not be allowed to enter a field of any kind without a ring in the nose. Their propensity to dig for worms and roots makes them turn up the soil with their noses, and when a grass-field is thus treated, it presents a perfect scene of havoc, in so far as the grass is concerned. The best material for making the nose-jewels of swine is horse-shoe nails, they being both durable and ductile. As there is no use of retaining the heads of the nails, they are hammered into a point, and the nail is then fit for use. It is inserted into a hole, formed by an awl or other sharp-pointed instrument, through the upper point of the snout, and passing, with a good hold, through the cartilage of the top of the snout to its front, where the points of the nail are twisted firmly together. A new hole can be made in the snout, and another nail substituted, when the old hole and nail have become worn.

* Henderson's Treatise on the Breeding of Swine, p. 41-5.

60. OF THE HATCHING OF FOWLS.

. . . . . The careful hen
Calls all her chirping family around;
Fed and defended by the fearless cock,
Whose breast with ardour flames, as on he walks,
Graceful, and crows defiance. In the pond
The finely chequered duck before her train
Rows garrulous. . . . . .
. . . . . The turkey nigh,
Loud threat'ning, reddens; while the peacock spreads
His every colour'd glory to the sun,
And swims in radiant majesty along.
O'er the whole homely scene, the cooing dove
Flies thick in am'rous chase, and wanton rolls
The glancing eye, and turns the changeful neck."

THOMSON.

(2471.) Spring is the busy season of the feathered inhabitants of the farm. Thomson well describes the "homely scene," which these happy creatures present while tending their young, and which might be seen at every farm-stead in spring, were fowls cared for as they should be. Instead, however, of indulging in unavailing regrets, I shall endeavour, in as few words as the clear elucidation of the subject will admit of, to describe the mode of hatching and rearing every sort of fowl usually domesticated on a farm, and thereby shew you that it is not so difficult nor so troublesome an affair as the practice which generally prevails would seem to indicate. Observation of the habits of domesticated birds, and *punctual* attention to their wants, are all that are required to produce and bring up plenty of excellent poultry on a farm.

(2472.) In my observations on the management of *hens* in winter, I mentioned that the early-hatched chickens of the former spring were the best to treat as laying hens during winter (1708.). These same young hens being in fine condition in spring, will prove good layers through the ensuing summer, and should therefore be kindly treated for that purpose, and not encouraged to become sitters on eggs, which they will do, if allowed to wander in search of food, and to find out nests of their own to lay in. I also mentioned, that there was no great difficulty of bringing up chickens in winter, if it were thought expedient to do it, and should any have been nursed in winter (1709.), they will now in spring be in good condition, and be valuable birds, fit to make a handsome dish of roast or boil.

(2473.) As soon as the grass begins to grow in spring, so early will

cared-for hens delight to wander into sheltered portions of pasture, in the sunshine, in front of a thorn-hedge, and pick the tender blades, and devour the tiny worms, which the genial air may have warmed into life and activity. With such morsels of spring food, and in pleasant temperature, their combs will begin to redden, and their feathers assume a glossy hue; and even by February their chant may be heard, and which is the sure harbinger of the commencement of the laying season. By March a disposition to sit will be evinced by the early laying hens; but every hen should not be allowed to sit; nor can any hen sit at her own discretion where the practice is, as should be, to gather the eggs every day as they are laid. It is in your own option, then, to select the hens you wish to sit to bring out chickens. Those selected should be of a quiet social disposition, not easily frightened, nor over careful of their brood, nor disposed to wander afar; and they should be large and full feathered, to be able to cover their eggs well, and brood their young completely. Those which you may have observed to be good sitters and brooders should be chosen in preference to others; but it is proper to begin one young hen or so, every season, to sit for the first time.

(2474.) The *eggs* intended to be set, should be carefully selected. If those of a particular hen are desired to be hatched, they should, of course, be kept by themselves, and set after her laying time is finished. In selecting eggs, they should, in the first place, be quite *fresh*, that is, laid within a few days; they should be large, well-shaped, truly ovoidal; neither too thin nor too thick, but smooth in the shell; and their substance should almost entirely fill the shell, and should be perfectly uniform and translucent, when looked through at a candle, which is the best light for their examination. It is said that the position of the cell that contains air in an egg determines the sex of the chick that will spring from the egg, that is, if the cell occupies the exact apex of the end, which is always the large end, the chick will be a male, and if on one side of the apex, it will be a female. I believe there is truth in this observation, but to what extent, and what experiments have been made to determine the point, I have not learned; but there is no doubt of this, that the longer an egg has been kept with access to the air, until it becomes addled or dead, this cell increases in size, by the absorption of air through the shell, and, of course, by absorption also of the substance of the egg, which makes room for the air. The matter of the sex of the egg is of no importance on a farm, as a good chicken of one sex is as valuable, as an article of food, as a good one of the other. Either 11 or 13 eggs are placed under a hen; the former number, 11, is more likely to be successful in being entirely hatched than the latter, as few hens can cover

in a sufficient manner so many as 13 large eggs. There is a freak, prevalent even at the present day, of the propriety of setting an *odd* number of eggs under a hen. This may have arisen from the idea, that allowing 1 egg to become rotten, an *even* number, or so many *couples* of chickens, will still be obtained in the hatching, and, accordingly, it is considered a good hatching if 10 chickens are brought out of a setting of 11 eggs, or a dozen of one of 13 eggs. As essential a matter as selecting the hens and eggs, is the making a proper *nest* for the sitting hen. This should consist of a circular hassock of soft straw-ropes, or it may be a box, or a basket. The object of this foundation is to raise the real nest sufficiently off the ground to keep it dry, and to give the nest such a hollow as that none of the eggs shall roll out by any mischance that may befall the nest. Either a box or a basket is a very convenient thing for the purpose, but in using either it will be requisite to stuff the corners, as well as the bottom, firmly with straw, that the eggs may not drop into the corners, or the young chicks, as they are hatched, fall into them. The nest itself should be made of soft short straw, sufficiently large to contain the hen, just sufficiently hollow to prevent the eggs rolling out, and sufficiently high above the floor to prevent any draught of air reaching the eggs.

(2475.) Places should be chosen for placing the sitting hens in, for the hen-house, common to all the laying hens, will not answer, the perpetual commotion in it disturbing the sitting hens. A hatching-house should contain one hen at a time, but as many may be accommodated in it as there are partitions to separate the one hen completely from the other, for hens are so jealous of each other, and, especially when sitting, that they will sometimes endeavour to take the nest and eggs from one another. Other places can be selected for sitting in, such as an out-house, a loft, a spare room in the farm-house, or even the back-kitchen. The hen selected for sitting having been accustomed to lay in the hen-house, or elsewhere, will feel annoyed at first on being transferred to her new quarters; she will have to be coaxed to it, and even after all may prove obstreperous, though exhibiting strong symptoms of clucking, in which case she must be dismissed and another chosen, rather than the risk be run of spoiling the whole hatching by her capricious conduct. A couple or so of old eggs should first be put into the nest, upon which she should be induced, by meat and water beside her, to sit for two or three days, to warm the nest thoroughly, before the eggs she is to hatch are placed under her. After she shews a disposition to sit, and the nest has become warm, the eggs are put into the nest, 11, as I said before, being quite enough, and the hen allowed to

go upon them in her own way, and to manage the eggs as she chooses, which she will do with her bill and body, spreading herself out fully to cover all the eggs completely. The time chosen for setting the hen should be in the evening, when there is a natural desire for roosting and resting, and by next morning, by day-break even, it will be found that she has taken to the nest contentedly. It is not an unusual practice to set a hen at any time of the day, even in the day-light, when she is almost certain to come off and desire to wander; and to curb this disposition, a tub, or some such vessel, is placed over her to keep her in the dark, and the consequence is, that the fright consequent upon such treatment, prevents her paying any attention to the eggs, and some may even be broken in her attempts to get out of confinement. In such an attempt to keep the creature in the dark, it might suggest itself to a considerate person, one should think, that darkness would be most easily and naturally found at night, and that natural darkness was better than any that could be made artificially. Thus situate, the sitting hen should be looked at occasionally every day, and supplied with fresh food, corn, and clean water. She will not consume much food during the time of incubation, which is 3 weeks. Every 2 or 3 days the dung, feathers, &c. about the nest or on the floor should be swept and carried away, and the place kept clean and dry. In about 3 weeks a commotion among the eggs may be expected; and should the hen have proved a close sitter, and the weather mild, it is not unlikely that 2 or 3 chickens will be seen peeping out below her feathers before that period. The hen should not be disturbed during the time the chickens are leaving the eggs, or until they are all fairly out and dry. Any attempt to chip an egg infallibly kills the chick; and every attempt to remove pieces of a chipped egg causes the chick to bleed. A good plan is to give the chickens, when fairly out, a drink, by taking them one by one and dipping their bills in water. Meat is then set down to them on a flat plate, consisting of crumbled bread and oatmeal, and a flat dish of clean water. The hen's food consists of corn or boiled potatoes, and water. The chickens should be visited every 3 hours, and a variety of food presented, so as to induce them to eat it the more frequently and heartily, such as picks of hard porridge, crumbled boiled potatoes, rice, groats, pearl barley; taking care to have their food always fresh, and their water clean, however small the quantity they may consume. The hassock, or box, or basket, should now be removed, and the true nest set down on the floor, with a slope from it, that the chickens may have the means of walking up to the nest to be brooded at night. In the course of 24 hours after all the chickens are on foot, the hen will express a desire to go out,

which she should be indulged in, if the weather is dry, and especially when the sun is out; but if it rain, she had better be kept within doors, unless there is a convenient shed near, in which she may remain with her brood for a short time. Visited every 3 hours during the day, and supplied with a change of food such as I have mentioned, and clean water, for about a fortnight, or until the feathers of the tails and the wings begin to sprout, chickens may then be considered out of danger, and, of course, become less of a charge to her who has the care of them. During the remainder of the season, the chickens should receive food 3 times a-day, consisting of potatoes boiled as they are used at table, as long as they last, and they might last the greater part of the summer, provided means were used to preserve them for the purpose; and the fact of being able to rear poultry cheaper on potatoes than on any other sort of food, is a sufficient inducement to preserve them as long as possible in a useable state. When potatoes fail, or even along with them, hard-made oatmeal porridge is an excellent food for fowls, when administered in small bits at a time. It is not expedient to set a number of hens at one time, but in succession every 3 weeks or a month; for a few chickens, ready in succession, are of greater value than a large number of the same age. As the season advances in summer, hens, as they become fat by picking up plenty of food in the fields, have a predilection to select places for nests in the fields, lay in them, and bring out chickens from their own eggs; and it must be owned that this is the most natural way of obtaining chickens; but no dependence can be placed for a supply of young fowls in this way, as the weather may not suit hens setting in the open air; and hens may not be in a state for laying a nestful of eggs in the most desirable part of the year, namely, the early and late periods of the season. In short, it is impossible to depend on a regular supply of either eggs or chickens, unless provision is made for collecting the one and hatching the other in a systematic manner. Chickens go 6 weeks with their mother. A good hen that has brought out an early brood will become so fat while rearing them, that she will in time begin again to drop eggs, and of course again become a clucker, and may then be employed to bring out a late brood. Cock-chicks, just out of the egg, are distinguished from hen-chicks by their larger heads and stronger legs.

(2476.) In regard to the hatching and rearing of *turkies*, it is universally said to be a very difficult matter to accomplish; an opinion I am by no means inclined to acquiesce in, for I am disposed to maintain that they are as easily reared as chickens, as may be seen in the sequel. When a turkey-hen is seen disposed to lay, a nest should be made for

her in the hatching-house. It may consist of the same materials as the hen's nest, but, of course, of a larger size to suit the bird. A box or basket is an excellent thing, with every corner filled up. When once the turkey-hen lays an egg, and a nest-egg is placed in the nest, she will use it regularly every time she requires it, which will be once in about 30 hours. As the eggs are laid, they should be removed, and placed gently in a basket in the house, in a *dry* place, and turned with caution every day. When she has done laying, which may not be till she has laid 12 or 13 or even 15 eggs, she will be disposed to sit, when the eggs should be placed under her, to the number of 11 or 13, the former number being the most certain of succeeding, as a turkey cannot cover a greater number of her own eggs than a hen can of hers; and a brood of 10 poults is an excellent hatching. Corn and water should be placed near the nest; but the turkey need not be confined within the apartment she occupies, though she is not disposed to wander, nor is she jealous of another one sitting in the same apartment with her. A turkey sits 4 weeks, and is proverbially a close sitter. During the incubation her food and water should be supplied to her fresh and clean daily, and all dung and dirt removed from her every two or three days. When the poults are expected to make their appearance, the turkey should be frequently looked at, but not disturbed, until all the creatures are fairly hatched. It is, I believe, a common practice to put a peppercorn down the throat of every poult a very short time after it is hatched. How this practice originated, I cannot say; but as turkeys, when at liberty, have a great relish for ants, and seem to possess an instinctive faculty in discovering their hills, it is possible that the peppercorn may operate as a substitute for the ant. It is known that ants yield a peculiar acid called *formic* acid; and it is not improbable that the pungency of the peppercorn may act as a stimulant on the stomach in the same manner as the acid in ants. Dr Thomson, in speaking of the origin of the formic acid, says, that "it is secreted by the *Formica rufa* or red ant, and is the liquid that renders the bites of these insects so painful. It was first publicly noticed by Mr Ray in the year 1670. . . . Mr Fisher had stated to Mr Ray several years before, that 'if you stir a heap of ants so as to rouse them, they will let fall on the instrument you use a liquid which, if you presently smell, will twinge the nose like newly-distilled oil of vitriol.' Mr Fisher farther stated, that 'when ants are distilled by themselves or with water, they yield a spirit like spirit of vinegar, or rather like spirit of *viride æris*. It dissolves iron and lead. When you put the animals into water, you must stir them to make them angry, and then they will spit out their

acid juice.' Margraaf obtained this acid in 1749, by distilling ants mixed with water and rectifying the liquid that came over. The acid obtained had a sour taste and smell."* While considering this acid, I may say a few words on the constitution of pepper. "*Piper nigrum* is the name of the plant which produces common pepper. It is a shrub which grows in India. The seeds are berries, round, hard, having an aromatic smell and a *hot acrid taste.* These berries constitute pepper. The unripe berries are the common *black* pepper; while the ripe berries, deprived of their epidermis, constitute *white* pepper. . . In 1821 M. Pelletier published an elaborate examination of pepper. He shewed that it contained the following constituents:—

Piperin.	Malic and tartaric acids.
A solid very acrid oil.	Starch.
A balsamic volatile oil.	Bassorin.
A gummy-coloured matter.	Lignin.
Extract similar to that obtained from leguminous seeds.	Earthy and alkaline salts in small quantities.

M. Pelletier shewed that piperin did not possess alkaline characters, as Oestedt had supposed, but that it was a peculiar principle. He found, too, that pepper owed its peculiar *taste to a volatile oil.* This I had shewn many years before," adds Dr Thomson.† From this account of it, it is not improbable that the solid and very acrid oil in the pepper may operate on turkeys in a similar manner to the formic acid in ants; and this may form an excuse for an old practice for which a sufficient reason cannot be given by those who follow it. After the peppercorn is given, and it may be given or not as the person who has charge may choose, the poults get a drink of water, and are returned into the warm nest where the mother receives them with characteristic fondness. But before leaving the turkey for that night, the box or basket in which the nest is formed should be taken away, and the nest brought down upon the floor, with a sloping face towards the floor to enable the young poults to gain the nest. For 24 hours the poults will eat nothing, though the turkey herself should be provided with corn or potatoes and water. Next morning the young creatures will be quite astir and ready to eat food, which should now be given them. It should consist *solely of hard-boiled eggs, yolks and white shreded down very small,* and put on a flat plate or small square board. In one respect turkey-poults differ in their nature from chickens, inasmuch as they are more apt to purge for about

* Thomson's Chemistry of Animal Bodies, p. 7.

† Thomson's Chemistry of Vegetables, p. 895.

the first fortnight of their existence, and when purging does overtake them it is difficult of cure, and indeed generally proves fatal; but hard-boiled eggs, forming an astringent and nourishing food, entirely *prevent* purging, and are better for them than some other things I have seen tried. For instance, for the sake of experiment, hard-made oatmeal-porridge was given instead of hard-boiled eggs, and in a short time two poults took the flux and died, the rest having been saved by a return to the egg. With egg not a single death has occurred among one to two hatchings every year for upwards of 20 years, and that is surely sufficient experience to justify the recommendation of any practice. Let the poults be visited every 3 or 4 hours, supplied with hard-boiled egg and clean water. Let their food be removed after the poults are served, otherwise the turkey-hen will devour it, for she is a keen feeder, and not so disinterested a bird as a hen. Let them remain 2 nights and a day in the house, and after that let them go into the open air and enjoy the sun and warmth, of which, it is hoped, there will be plenty in the month of May. In wet weather, however, they should either be confined to their house, or allowed to go into a shed. When the birds become strong and active, in the course of a few days let the turkey be placed in a coop on the green to curb her wandering propensity, until the poults can follow her, which they will be able to do after they have partaken of the hard-boiled egg for a fortnight. Their meat can be put down on a plate on the green beyond the reach of the coop, and where the poults can help themselves, whilst the food of the turkey is placed within reach of the coop, consisting of corn, and potatoes, and water. After the feathers in the tails and wings of the poults are beginning to sprout, the egg may be gradually withdrawn, and hard-boiled picks of porridge, with a little sweet-milk in the dish, to facilitate the swallowing of the porridge, should be given them at least 4 or 5 times a-day at stated hours, and will make wholesome food, until the mother can provide insects and other natural food for them, which will form a desirable variety with the food given them, and then they will thrive apace, and grow amazingly fast as the weather becomes warm. Should the grass be damp, let the coop be placed on the gravel of the road or walk, as dampness is injurious to all young birds of the gallinaceous tribe. After the egg the poults are fond of a little shreded cress and mustard, and when at full liberty, they will pick the leaves of nettles with avidity. These predilections for ants, cress, and nettles, shew that turkies enjoy stimulating condiments with their food.

(2477.) Turkies are sometimes extraordinary layers. One season a hen-turkey of my own, after bringing up 11 poults till they were 8 weeks

old, made a nest in the middle of a large bush of nettles at the edge of a young plantation which she visited, and contrived to slip away unnoticed from her brood to lay an egg in *every day*. The nest was soon discovered, the egg taken away every day as it was laid, and a nest egg left in it, and thus she continued to visit it daily until she had laid the extraordinary number of 90 eggs. The consequence of this oviparous fecundity was, that the turkey did not moult till the depth of winter, and the moulting was so very bare that she had to be confined to the house; and whether the catastrophe which befel her before spring was owing to the severity of the late moulting I do not know, but an inflammation and a consequent swelling seized one of her eyes, and she was deprived of its sight. By spring, however, she recovered from the moulting, was furnished with a complete set of new feathers, the wound on the eye healed, but somehow she died in a very short time after. Turkey-hens are most watchful protectors of their young, and are particularly wary of birds of prey, which, whenever observed, even at the greatest height in the air, they will utter a peculiar cry, and every poult will instantly hide itself amongst the longest grass and other plants within reach. There is another peculiarity in regard to the turkey-hen; one impregnation from the cock fecundates all the eggs of the ovarium; and on account of this property, I am told it is not uncommon in spring in Ireland to see people carrying about a turkey-cock and offering his services at farm-steads as those of a stallion are proffered. It is perhaps owing to this peculiar constitutional habit of the turkey that makes the cock so regardless of his own progeny; and, indeed, the hen voluntarily shuns his attention when in charge of her brood. The brood goes with her for an indefinite length of time.

(2478.) In regard to *geese*, they make early preparation for incubation. There are couplets in existence indicative of the period of commencement of their laying, namely,

"By Candlemass day, Good goose will lay."	And,	"By St Valentine's day, Good and bad goose will lay."

Geese, however, seldom lay in Scotland till the end of February. The goose and gander cannot embrace but in water, and if the pond which they frequent be covered with ice, it should be broken to allow them to get to the water, and every egg requires a separate impregnation. An attentive observer will know when a goose is desirous of laying by her picking amongst straws and placing one on this side and one on that of her, as if making a nest. Whenever this is noticed, or an embrace on the water, a nest should be made for the goose to lay in in the hatching-house, and to which she should have easy access, for she cannot jump up

with the nimbleness of either a hen or a turkey, though her nest may be made in a box or basket, in the same manner as that of the hen, but of a size to suit the bird intended to occupy it. It is not proper to confine a goose a long time before laying her first egg; but when symptoms of being with egg are observed, she should be caught in the morning, when let out, and the lower portion of the soft part of the abdomen felt, where the egg may be easily ascertained to be in a state or not for being immediately laid, and if it feel hard, the goose should be shewn her nest and confined to it until she lays in the course of the day, after which she is of course let out, the egg taken away and kept dry in a basket, and turned every day, until the whole are placed under her. Every other day after this the goose will visit her nest and lay an egg, and the number she may lay will seldom exceed 12, though 18 have been known to be laid; so, by the time she is done laying, it will be about the end of March. There is, however, considerable difference in this respect with geese, on some farms they being considerably earlier in hatching than on others. This may arise from the nature of the soil, for it is probable that a dry, sharp, early soil for grass and grain, will also early promote the functions of the animals that live upon it. After the goose has finished laying her eggs she will incline to sit, and then is the time for her to receive the eggs; and the best time for placing her upon them in the nest, as I have said before, is in the evening, that, by the arrival of the morning, the nest being warm and comfortable, the goose will have no inducement to leave it. The number of eggs given to be hatched should be 11, which is as many as a goose can conveniently and easily cover. The goose plucks the down off her body to furnish her nest with the means of increasing its heat; and one great use of the down is, that when she leaves her nest at any time it serves the double purpose of retaining the heat about the eggs and of preventing the external cold affecting them. A little clean water and a few oats are put beside a goose when she is sitting; but she will eat very little food all the time of her incubation. A feed of good oats, such as is given to a horse, will serve a sitting goose for a month, yet this little handful is actually grudged the goose, and instead of good corn, only little better than chaff, the lightest corn that is blown from the fanners, is only allowed by many farmers who consider themselves very good managers. Some hen-wives will not allow the goose to go abroad as long as she is sitting; but this is an unnecessary constraint upon her. Let her go off whenever *she pleases*, and there is no fear but that she will return to her nest in time to retain the heat of the eggs; for she makes it a point to cover every egg with down before leaving the nest. Most people will not allow her to go to the water at all, alleging, that if she return wet upon her eggs, they will become addled,

but this is a mistake. Let her go to the pond if she wills it, and wash herself in it, and, depend upon it, she will not continue long there; she will be cooled and much refreshed by it. The feathers will not become *wet;* it is not their nature to become so; and after such a relaxation, which she much enjoys, she will sit the closer. Geese are liable to become costive while sitting, and to counteract this tendency, they should be supplied now and then with a little boiled potato in a dry state, which they will relish much, and feel much the better for; and, indeed, every fowl, while sitting, should receive a little of this useful succedaneum at that peculiar juncture. The gander usually takes up with one mate, but if there are only two geese, he will pay attention to both; and his regard for his mate is so strong, that he will remain at the door of the hatching-house like a watch-dog, guarding her from every danger, and ready to attack all and sundry who approach her sanctuary. At the end of a calendar month the eggs may be expected to be hatched; and during this process the goose should be left undisturbed, but not unobserved. After the goslings are all fairly out of the shell, and before they are even dry, they may be taken in a basket with straw to a sheltered dry spot in a grass-field, the goose carried by the wings, and the gander will follow the goslings' soft whistle. Here they may remain for an hour or two, provided the sun shines, for in sunshine goslings will pick up more strength in one hour than all the brooding they can receive even from their mother for a day. The goose will rest on the grass, the goslings will endeavour to balance themselves on their feet to pluck it, and the gander will proudly protect the whole. Water should be placed beside them to drink. Should the sky overcast, and rain likely to fall, the goslings should be collected, and they and goose carried instantly to their nest; for if goslings get their backs wetted with rain or snow in the first two days of their existence, they will lose the use of their legs, never recover their strength, and inevitably die. Should the weather be wet, a sod of good grass should be cut and placed within their house, with a shallow plate of water. In setting down a common plate to goslings, it should be prevented from upsetting, as they are apt to put their foot upon its edge, and spill the water. After two days' strength, and especially in sunny weather, the goslings may venture to the pond to swim; but the horse-pond is a rather dangerous place for them as yet, so many creatures frequenting it. Some water, or a pond, in a grass-field, would be a better place for them. For the first two or three days after goslings go about, they should be particularly observed, for should they in that time happen to fall upon their backs, or even into a hardened hoof-print of a horse, they cannot recover their legs, will be deserted by their dam and the rest of the flock, and will perish. After three or four days,

however, in dry sunny weather, and on good grass, they will become strong, grow fast, and be past all danger. It is surprising how rapidly a young gosling grows in the first month of its life. After that time they begin to tire of grass, and go in search of other food; and this is the time to supply them daily with a few good oats, if you wish to have a flock of fine birds by Michaelmas; any other grain will answer the purpose, as rice and Indian corn, let it be but corn, though oats are their favourite food. Even ordinary light corn will be better for them than none; and if they get corn only till harvest, they will have passed their most growing period of their life, and will then be able to shift for themselves, first in the stack-yard and afterwards in the stubbles. The sex of the gosling may be easily ascertained after the feathers begin to sprout, the ganders being white, and strong in the leg, head, and neck; the geese are grey and gentler-looking. Goslings go with their parents for an indefinite length of time.

(2479.) Geese are in general close sitters; but sometimes they become as capricious as to forsake some of their eggs after a number of them have been hatched. An instance of this sort of desertion I have witnessed. A goose after hatching 5 goslings, deserted her nest and would no longer sit on the other 6 eggs to bring them out, though one of them was chipped. Fearing that the deserted eggs would perish from cold, my housekeeper—who took the charge of all the poultry, cows, and calves, besides the duties of the house—brought the eggs into the house, put them in a basket amongst flannel and wool, caused the oven to be gently heated, placed the basket with the eggs in the oven, and continued the heat in it night and day until all the goslings were hatched, which they were one by one, excepting one in which the bird had died. The young creatures occupied some days in leaving their eggs, and longer than they would have done under the goose. They were carefully attended to and were taken out to the grass in the best part of the day, kept warm in the house at night, and, when the weather was such that they could not get out, a grass-sod was brought to them into the house. The goose refused to take her own broken brood when offered to her, after they had gained sufficient strength to go about; and this being the case, they were brought up without her aid, and became as strong birds as those of her own outbringing. I consider this a remarkable instance of the resources of a ready mind, and of disregard of personal trouble; and it is an encouraging example of perseverance in an attempt to preserve the lives of useful animals under very inauspicious and even provoking circumstances.

(2480.) *Ducks* begin to lay eggs early in the season, as early as Febru-

ary, so it is possible to obtain an early hatching of ducklings, if desired; but early ducklings are not desirable, for, during that unnatural period for them, they do not acquire much flesh, even with the utmost care; their bills and bones grow disproportionately large, and altogether the experiment does not succeed. It is early enough to set duck-eggs in Scotland by May, and by April in England. It is customary to place duck-eggs under hens, owing, I believe, to the great difficulty of making a duck take to a nest which she has not herself made. Hens make pretty good foster-mothers to ducklings, though, in becoming so, the task is imposed upon them of a week's longer sitting than is *natural* to them, and, after all, the natural plan is for ducks to bring out their own kind; and there is no doubt that, when a duck does choose a nest for herself, lines it with her own down, and brings out a brood, that the ducklings are better than any reared under the auspices of a hen; the instinct of the duck being more congenial to ducklings in leading them to places in search of food peculiar to their tastes, as well upon land as upon water. Still the entire production of ducklings on a farm should not be left to the chance of ducks setting themselves on eggs, for they are proverbially careless of where they deposite their eggs, and on that account hens must be employed to hatch at least a few broods.

(2481.) As in the case of her own eggs, a hen can only cover 11 duck-eggs with ease, and, of course, she requires the same treatment when sitting on them as she receives with her own eggs. A calendar month is required to bring out ducklings; and the hen should be left undisturbed until all the brood comes out. Ducklings should be kept from water for a couple of days, until their navel-string is healed; and the food which they receive should be of a soft nature, quite the opposite of that given to turkey-poults, such as bits of oatmeal porridge, boiled potatoes, bread steeped in water, barley-meal brose, and clean water to drink in a flat dish in which they cannot swim. On this treatment, 3 or 4 times at least every day, they will thrive apace, and become soon fledged in the body, when they are fit for use; but their quill-feathers do not appear for some time after. In this state wild-ducklings, under the name of *flaffers*, make good sport, and are an excellent dish with green peas, when stuffed with onion and sage shred small, and a little pepper and salt amongst them, and roasted, and served up in a hot sauce of port wine seasoned with pepper and mace.

(2482.) A great number of ducklings are bred and reared every year at Aylesbury in Buckinghamshire, for the London market, by people of the poorer class. The eggs are hatched by hens, and 3 or 4 broods are put together into one division; whilst other divisions contain them

in a different state of growth, some half grown, others full fledged, and all are fed alike. In this way one person has 300 or 400 ducklings feeding about his house, and perhaps under the same roof with his own family. A great many are housed in little space, and never allowed to go at large; but are permitted to wash themselves every day in a pond made on purpose near the house. They are fed three times a-day on potatoes, barley-meal, bran, greaves, &c., and receive as much as they can eat; and it is said that they can eat an incredible quantity of food while thus forced for the market. When full-feathered they are sent to London, where they find a ready sale, at from 6s. 6d. to 8s. a pair. As the season advances, prices fall, till they reach 3s. a pair, when the breeding is given up for the season. These people allege that they are not remunerated for their trouble even at the highest prices.

(2483.) *Pea-hens*, in their hatching, cannot be subjected to control. The hen selects a secluded spot for her nest, not unlikely in the garden, where she feels herself secure from the attentions of the cock, whom she seems to avoid at this season, with marked assiduity. She takes care that he shall not know, not only where her nest is, but when the pea-fowls come out, because, as is alleged, the cock would destroy them. A pea-hen in this country seldom brings out more than 3 or 4 birds, though usually laying 5 eggs; and these she tends with great care, taking them to places where wild food can be found in greatest abundance, such as insects of various kinds and in different states, and grain, whilst they are fed as young turkies; and she continues her attentions to them for the greater part of the year.

(2484.) *Pigeons*, when their dove-cot is favourably situated for heat, begin to lay in February, and will continue to do so until December. They make their own nests, which are of the simplest and rudest construction, and, indeed, the same nest will be used by the same pair season after season, even after it has been much elevated with dung. A fine nest is not required by pigeons, which only laying 2 eggs at a time, one of each sex, the hen can easily cover them; and to secure them still more, she pushes them below her with her bill, amongst the feathers, to keep them warm. A supply of young pigeons might be found at the farmer's table all summer. To vary their cookery, they can be stewed, roasted, broiled, and made into pies, one and all of which, when properly seasoned with pepper, salt, onions shred small, and butter, makes a savoury appendent to any dinner. While touching on cookery, I may remark, in regard to other poultry, that a young chicken roasted or broiled, when in perfection, at 14 weeks old—a young cock especially, or boiled—a young hen being the more delicate—with a slice of ham, cured as directed in winter,

from (1678.) to (1681.) inclusive, is a standing delicacy at a farmer's table. Ducklings and green peas are seen for a short season in the early part of summer, but a roast duck may be had all autumn and the early part of winter. Turkey-poults are never indulged in by the Scottish farmer, probably from the idea that they have too little flesh upon them, and are too similar to boiled chickens; and as chickens are more plentiful, and can be used with less scruple, the poults are spared until they attain full size. Young geese are never seen at a Scottish farmer's table, though a stubble-goose at Michaelmas seems to be prized in England. With regard to the means of supplying young fowls on a farm, 2 turkey-hens and 2 geese will rear as many turkeys and geese as will be required by a large family; 3 or 4 broods of ducks will suffice; a brood or broods of chickens may be brought out from March to November; and as to pigeons, it is the farmer's own fault if he has not a supply of them from March to December. Those who do not care for the flesh of fowls may send their poultry to market; and those who breed for the market should provide a person well versed in rearing poultry to undertake the duty.

(2485.) With regard to the feeding of fowls in summer, boiled potatoes and hard made oatmeal porridge should be their staple food; and so fond are all sorts of birds of potatoes, that there should some pains be taken by farmers to preserve a few of the best of them over the summer, for the express purpose of feeding poultry. I have described a plan of keeping them over year in a former paragraph (2408.). Food, when distributed for poultry, should not be laid down in a large heap in one place, when birds of different natures partake of it, and are therefore almost certain of quarrelling and fighting; but it should be scattered thinly along a bare piece of ground, or, what is better, upon grass, which keeps it clean, and from which it can easily be picked up, but it should not be laid amongst straw, as it is easily lost sight of amongst it. As different sorts of birds have different habits, and frequent different places, the food should be scattered for each kind as near their usual habitats as their natures indicate, and which the person who has charge of the matter can devise—scattering some near water for geese and ducks, upon the margin of grass on the side of the road near the steading, for hens, and at a more retired place, though still upon grass, for the turkeys; and the food should thus be laid down for the different sorts of fowls at a fixed hour at morning and afternoon. Cleanliness, attention, regularity, and good food, constitute the grand secret of rearing poultry to the highest perfection.

(2486.) What I have described of hatching the different sorts of

fowls usually reared, is suitable to every sort of farm, and may be acquired by any domestic of the farm-house; and that it is a practicable scheme, my own experience has demonstrated. Other schemes are recommended in books, and large establishments, consisting of buildings and ponds, and spare ground, are erected in the parks and farm-courts of country gentlemen; but let any other plan be what it may, and the erections and other appliances of whatever magnitude, there is none, I feel confident, will afford poultry at all times in a higher degree of perfection than the simple one I have been describing, and recommending for your adoption—and experience is the true test to which every plan should be subjected. I do not hold it out as a peculiarly cheap plan, that is, that it will supply *good* poultry for the table at *little or no cost*, though that is the idea of cheapness entertained by farmers, when they condescend to cast a thought on the poultry of their farms. I will not say, because I do not believe it, that fowls can be reared for nothing, or upon the *refuse* of the products of a farm; because, when I see that it requires the best oats, the best turnips, and the best grass that a farm can raise, to rear such horses, cattle, and sheep, as purchasers desire to have, I cannot believe that the *best* poultry can be reared but on the *best* sort of food suited for them; but this I will say for the plan, as a practicable one for an ordinary farm, that it requires no costly buildings, and that it will assuredly yield poultry in good condition at all times in return for the food and trouble bestowed upon them, and what more can any reasonable farmer desire?

(2487.) Fowls are kept in towns in places quite unsuited to their habits; most frequently in a small court, surrounded by a high rail, except on the side in which the hen-house is situated; and this consists of a flattish-roofed out-house, pervious to rain and redolent of moisture,—a condition the very worst for fowls. The floor of the court is generally covered with dirt, and the small vessel which is intended to contain water is as often dry as plenished with *clean* water, while the food is thrown upon the dirty court-floor. Add to these sources of discomfort, the sun, probably, never shines upon the town hen-house, or only for a few minutes in the afternoon, when the fowls are about to retire to roost. Ducks are treated in even a less ceremonious manner than hens; having no water, their feathers become begrimed with dirt, and their food is given them in a state little else than a puddle. It is, of course, impossible that fowls can *thrive* in such circumstances, and, indeed, a sight of the poor creatures excites nothing but commiseration for their fate. What can induce people to keep animals in such a state of filth and suffering, is what I cannot conceive. One cause of suffering to hens in such situations, is the want of sand or gravel to assist the trituration of food in the stomach. It is found that gallinaceous birds require a supply of quartzy substances, and these they find on any farm, as also calcareous matter, such as lime, to assist in the formation of the shell of the egg, without which, hens will lay what are called *wind* eggs, that is, eggs without a *hardened* shell. In the case of the fowls on board a certain East In-

diaman getting unwell in their coops, notwithstanding the attention daily bestowed, and the good food allowed them, it was discovered by the surgeon, on dissection of some of the birds which had died, that the cause of death was the want of gravel to assist the digestion of food. A supply of stones to beat down small was obtained at a convenient port, and the fowls became healthy, and continued so afterwards. Another source of suffering of a similar nature to hens, is the want of dust to flutter amongst their feathers in order to destroy the vermin that annoy their skin; and the want of water for the ducks to wash in and clean themselves.

(2488.) With the diseases of chickens or other young fowls, such as the *pip* or *chip*, I am not acquainted, not having seen any such disease after an experience of many years in rearing every species of fowl that is found on a farm, and, of course, I am inclined to maintain, that were others to follow a similar course to the one I have so successfully pursued, they would have equal success, and witness as few diseases amongst their poultry as I have. I am corroborated by a writer on the rearing of domestic poultry, whose experience I know is considerable,—whose attention I am sure is unremitting,—and whose good sense is evident. "Of the diseases of which poultry are liable, we are practically ignorant," says the writer, a lady of my acquaintance, "having been for many years here so fortunate as to experience few or no instances of disease among our stock; and we attribute the health of our various animals in the farm-yard *entirely to strict attention to cleanliness, diet, and rational treatment.* Those who listen to advice of the ignorant and the prejudiced, nay, they who seek from books remedies for disorders which may appear among their live-stock, will have to contend with monstrous absurdities, excessive ignorance, and barbarous cruelty, in the quackeries recommended. Nature will generally effect a cure, if her efforts are seconded by simple means on our own part. Calomel, sulphur, rue, pepper, and gin, are all absurdities, though all recommended for the ailments of poultry." Another writer thus expresses himself on the same subject: "With regard to medical treatment applied to the diseases of poultry, but little regarding its efficacy is known. The nostrums and mode of treatment adopted throughout the country, together with the greater part that has been written upon the subject, is a farrago of nonsense and absurdity. *If shelter, warmth, food, and cleanliness, congenial to their habits, will not preserve them in health, but little reliance can be placed upon medicine.* Most good wives, however, possess an insatiable itching to be considered skilful doctors. From among some thousand birds that have come under my observation, *I never could discover that common and universal disease* called the '*pip*.' Yet shew any farmer's wife a sickly chicken, and she immediately opens its mouth, and with her needle tears off the cartilage from the under part of the bird's tongue, to shew it is afflicted with it! When will the light of knowledge banish these absurdities!*" The former writer, however, alludes to an ailment among chickens which I have never seen, arising, it would appear, from their being hatched at a particular period of the year. After adverting to the tender state of chickens superinduced by both early and late hatching, the writer particularizes the period of the year when the disease alluded to makes its appearance:—"There is yet another time, during which it is *absolutely indispensable that hens be prevented from sitting, and that is the month of June.* Close observation (after having suffered at that

* Bucknell's Eccalcobion, p. 15.

season numerous failures most unaccountably) enabled us to discover the cause, and thereby verify the truth of an old saying, which we have since met with,—

'Between the sickle and the scythe,
What you rear will seldom thrive.'

We had noticed that chickens which were hatched during the month of July were almost all attacked about the time of their first moulting (a period always attended with much suffering to them) with a fatal disorder, the symptoms of which are unvarying. The chickens appeared to collapse, and moved about with difficulty, as if their joints were stiffened, or rather as if the skin had become tight and tender; their feathers became rough and stood out; their wings drooped and dragged on the ground; they refused sustenance; and becoming more and more weak and torpid, they, in a day or two, died off in great numbers. Every rational means were resorted to in order to arrest, or even account for the disorder; at length it was discovered that they were in a high state of fever, and that the extreme redness of the skin was caused by the irritation of hundreds of that minute pest the harvest-bug. Some—very few—were recovered by anointing them all over with oil and vinegar (which is also the best, nay, the only remedy for the annoyance which human beings experience from the same source); but the receipt is too rough for little delicate creatures already enduring the pain attendant on the season of moulting. It became obvious that the period during which harvest-bugs are most numerous and tormenting must be inimical, to the rearing of chickens; and that if hens were not allowed to sit in June, or rather, if the chickens were either strong enough to cope with the evil, or were not hatched until the season for the pest had passed by, the destruction might be prevented, and so it has proved."*

(2489.) On considering the hatching of fowls, the mind is naturally led to the curious artificial system of hatching which the ancient Egyptians practised, and which afforded them an immense supply of poultry every year. It is unnecessary to detail the ancient mode of hatching as it is unsuited to this country, our climate being much too unsteady for the purpose; but particular accounts of it may be found detailed by authors.† The Modern Egyptians still practise the system, and as the results exhibit some extraordinary facts, I am tempted to give the following account of it from Mr Mowbray. "Sicard," he says, "gives an idea of the immense quantities of chickens hatched in his time in Egypt. The number of ovens for hatching the eggs, dispersed in the several cantons of the country, was no less than 386. The business seems to be monopolized by the Agas or government, and therefore cannot be varied in extent but by their permission. Each *mamal* or oven has one managing Bermean, a native of the village of Bermé in the Delta, by whom the art of managing it has been retained, and is taught to his children. These managers cannot absent themselves from duty but with leave obtained from the Aga of Bermé, never obtained but at the expense of 6 to 10 crowns. The Aga constantly keeps a register of these fees, which to him is a sort of rent-roll. The above number of ovens is kept at work in Egypt annually during 4 to 6 months, allowing more time than is necessary to hatch 8 successive broods of chickens, ducks, and turkies, making in the whole, yearly, 3088 broods. The number in each hatching is not always equal, from the occasional difficulty of obtaining a sufficient number of eggs, which may be stated at a medium between the two ex-

* Quarterly Journal of Agriculture, vol. viii. p. 515 and 523.

† Wilkinson's Manners and Customs of the Ancient Egyptians, vol. i. p. 134. New Series.

tremes of 40,000 and 80,000 to each oven. The Bermean contracts to return, in a living brood to his employer, $\frac{2}{3}$ds of the number of eggs set in the oven; all above being his own perquisite in addition to his salary for the season, which is 30 to 40 crowns, exclusive of his board. According to report, the crop of poultry thus artificially raised in Egypt was seldom or never below that ratio, making the enormous annual amount of 92,640,000. It is obvious that the apparent grand difficulty of obtaining a sufficient number of eggs must subsist chiefly or entirely in the infancy of such an undertaking, and that its progress must infinitely extend that supply, as has been the case in Egypt, where the breeding stock has been so multiplied, and where, in consequence, the commodity is so cheap from its superabundance, that in the time of Sicard 1000 eggs were sold for 30 or 40 medims, making 3s. or 4s. English money. Indeed, the chickens were not sold from the stores by tale but by measure; according to Raumeur, by the bushel! And it appears from travellers of the present day, to be the custom in Egypt to purchase chickens by the basketful."* M. Raumeur, under the French Academy, instituted experiments to prove that eggs could be hatched in France as well as in Egypt, but it was soon discovered that the two countries were placed in different circumstances in regard to climate, and the project was abandoned as being impracticable. Plans of artificial hatching were tried with better success by M. Bonnemain, by a system of supplying heat from hot water in pipes; but the French Revolution put an end to the experiment. It is worth observing, in passing, how strange it is to hear of the circulation of hot water in pipes, as a steady source of heat, recommended at the present day as a *novelty*.† To supply the inhabitants of Great Britain and Ireland with fowls as the Egyptians are, namely, at the rate of $46\frac{1}{5}$ fowls to each person every year, the number that would require to be hatched, in the relative proportions of the populations of the two countries, would be 1,109,000,000 of fowls!

(2490.) A remarkable machine, exhibited in London some years ago, which I saw in the summer of 1839, was said to have attained the power of supplying the requisite degree of temperature for hatching for any length of time. It was the invention of Mr William Bucknell, and named the Eccaleobion, derived from two Greek words meaning "I give forth life," "Rationally to hope for success in the artificial hatching of eggs," says Mr Bucknell, "it becomes necessary to be in possession of a power completely to control temperature, independent of climate, seasons, or changes in the atmosphere; and also uninfluenced by them. These invaluable properties the Eccaleobion possesses, in a perfect and absolute command over temperature, from 300° Fahr. to that of cold water; so that any substance, submitted to its influence, shall uniformly be acted upon over its whole surface, at any required intermediate degree within the above range, and such heat maintained unaltered, without trouble and difficulty, for any length of time. By means, then, of this absolute and complete control over temperature, obtained by this machine, the impregnated egg of any bird, not stale, placed within its influence at the proper degree of warmth is, at the expiration of its natural time, elicited into life without the possibility of failure, which is sometimes the case with eggs subjected to the caprice of their natural parent."‡ Without attempting to describe the machine, I may mention that it is capable of containing

* Mowbray's Practical Treatise on Domestic Poultry, p. 81-91.

† Ure's Dictionary of the Arts and Manufactures, art. *Incubation, Artificial.*

‡ Bucknell's Eccaleobion, p. 12.

2000 eggs, which are open to the sight, through glazed doors, in different states of incubation, from the day the egg is inserted into it, until the bird is seen to leave it in the act of being hatched. It may be interesting, however, to relate a few of the facts regarding the condition of eggs in different states, as to their vitality, observed by Mr Bucknell in his experience of the machine.

(2491.) Few eggs are worth the trial of hatching if more than a month old; their condition, however, is greatly influenced by the season and the state of the weather. An egg retains its freshness longest in moderately cool weather; very hot weather destroys vitality in a few days; and an egg having been frozen is also worthless. Failures in hatching arise from want of impregnation in the egg—from age, commonly called staleness, whereby life has become extinct—from weakness of the vital energy of the eggs, produced by age, lowness of keep, or ill health of the parent, in which cases the chick partially develops itself, but dies before the full period of incubation. Eggs may be brought to life, but unless the process of incubation be properly executed, the birds will be weakly, ill-conditioned, and die in a short time afterwards. To prevent the yolk of weak eggs from settling by its specific gravity, and adhering to the shell, it is useful to pass the hand over them, so as to change their position every 24 hours. The egg of a strong healthy bird, at the time of its protrusion from the body, is completely filled with yolk and albumen. If examined a few days after, by holding it toward the light, a small cell of air will be discoverable at the larger end, which increases with the age of the egg. This waste of its internal substance is occasioned by absorption of the atmosphere, through the pores of the shell, of the more volatile parts of its contents. When the cell is large in any egg, it is unfit for incubation; nevertheless, in a good egg, as incubation proceeds, this cell becomes considerable, produced probably both from evaporation by heat, and the vital action going on within the shell. It also serves an important purpose in the economy of this mysterious process. An egg will not hatch in vacuo.

(2492.) The progressive series of phenomena daily observable during the process of incubation, in the egg of a common fowl, are curious and instructive. In an impregnated egg, previous to the commencement of incubation, a small spot is discernible upon the yolk, composed of a membraneous sac containing fluid matter in which the embryo of the future chick swims. 1st Day: At the expiration of 12 or 14 hours after incubation has commenced, the matter within the embryo evidently bears a resemblance to a head—vesicles assume the shape of the vertebral bones of the back. 2d Day: In 39 hours the eyes make their appearance—vessels joined together indicate the navel—the brain, spinal marrow, rudiments of the wings, and principal muscles—the heart is evidently proceeding. 3d Day: At its commencement the beating of the heart is visible—some hours after, two vesicles containing blood appear, one forming the left ventricle and the other the great artery—the auricle of the heart is next seen, and pulsation is evident. 4th Day: Wings assume a defined form—the brain, the beak, the front and hind parts of the head visible. 5th Day: Liver seen—circulation of the blood evident. 6th Day: Lungs and stomach distinguishable—full gush of blood from the heart distinct. 7th Day: Intestines, veins, and upper mandible visible—brain becomes consistent. 8th Day: Beak opens—formation of flesh on the breast. 9th Day: Ribs formed—gall-bladder perceptible. 10th Day: Bill formed—first voluntary motion of the chick seen. 11th Day: Skull becomes cartilaginous—protrusion of feathers evident. 12th

Day: Orbits of sight appear—ribs perfected. 13th Day: Spleen in its proper position in the abdomen. 14th Day: Lungs enclosed within the breast. 15th, 16th, and 17th Days: Mature state approached—yolk of the egg still outside of the body. 18th Day: Audible sign of life outside the shell—piping of the chick heard. 19th, 20th, and 21st Days: Increase of size and strength—yolk enclosed within the body—chick liberates itself by repeated efforts made by the bill, seconded by muscular exertion of the limbs.

(2493.) The embryo of the chick is not in every egg placed precisely in the same situation, but varies considerably. Generally it develops itself within the circumference of the broadest part of the egg; sometimes it is found higher, sometimes lower; and when held before a strong light, has an appearance, when a few days old, somewhat resembling the meshes of a spider's web, with the spider in the centre. As it increases in size, the bulk of the contents of the egg decrease, so that when the bird is completely matured, it has ample space to move, and to use its limbs with sufficient effect to insure its liberation. The position of the chick in the shell is such as to occupy the least space. The head, which is large and heavy in proportion to the rest of the body, is placed in front of the belly, with its beak under the right wing; the feet are gathered up like a bird dressed for the spit, yet, in this singular manner, and apparently uncomfortable position, the bird is by no means cramped or confined, but performs all the necessary motions and efforts required for its liberation with the most perfect ease, and with that consummate skill which instinct renders almost infallible. The chicken, when it breaks the shell, is heavier than the whole egg was at first.

(2494.) "If chickens about 2 months old and upwards," says Mr Bucknell, "are turned in among a brood of young birds that have no mother, they will sometime take to brooding and tending them with the delight of natural parents. The gratification being quite mutual, the young chicks run after and strive with each other for their favours with the most untiring perseverance. Although, probably, it is simply the pleasurable sensation derived from the genial warmth communicated by the young birds nestling under them which induces them to do it, it is nevertheless a striking and highly interesting picture to witness these mimic mothers acting the part of foster parents with so much apparent satisfaction, yet with the awkwardness with which a girl, in similar circumstances, fondles her doll." I never witnessed such an instance of affectionate regard, possibly because I never saw a brood of chickens deprived of their mother, but the sentiments conveyed in the following sentence I have frequently seen realized, and can testify to the accuracy of observation and the correctness of the conclusions of Mr Bucknell:—"There is no difficulty," he says, "in teaching the young of the various tribes of gallinaceous fowl to eat and to drink; they perform these operations spontaneously, or from observation, as appetite prompts them. Are not the facts of the extraordinary fecundity of these tribes, their requiring no assistance in hatching, and their being self-instructed in the manner of taking their food, abundant evidence that an All-wise Providence ordained these peculiarities expressly for man's advantage; as in all those families of birds not so fitted for his use, they do not exist, and consequently cannot be rendered by artificial means available for his benefit? Food is not necessary for the chick until 12 or 24 hours after leaving the shell. Sickly and badly hatched birds seldom can be induced to eat, and die from inanition. Birds but a few hours old recognise the person who feeds them, and in a few days evince

so many and such pleasing traits of confidence in her as their protector and friend, following her steps, and clamorously repining at her absence, as must induce in the most callous breast a delightful sensation of regard for their welfare."

(2495.) It is of some importance to farmers to have the question answered in a practical sense, Whether the hatching and rearing of *chickens* is profitable? Hear Mr Bucknell's answer to this question, as it affects artificial hatching: "Mr Mowbray, in his standard work," says Mr Bucknell, "gives the consumption of food by birds in the highest state of condition as follows:—'By an experiment made in July 1806, a measured peck of good barley kept in a high style of condition the following stock, confined, and having no other provision: 1 cock, 3 hens, 3 March chickens, 6 April, and 6 May chickens, during 8 clear days, and one feed left.' Here, then, are 19 birds, varying in age from 2 months to their full size, consuming 1 peck of corn in 8 days, which, at 1s. per peck, gives a cost of $1\frac{1}{8}$ halfpenny per head, which, however, is considerably above the cost of *chickens* for the first 8 weeks of their existence. But taking it at this high average, it gives an expense of each bird of 9d. all but a fraction for 14 weeks' keep, at which age they are in the highest perfection, being the most delicate and easy to digest of all other animal food. Where they can enjoy the advantage of a good run, the expense would still be lessened perhaps $\frac{1}{3}$. Now, what is the price at a poulterer's, or in the London markets, of a fine fat chicken 14 weeks old, or nearly its full size? Never less than 2s., and for 6 months in the year, or during the dear season, 4s. or 5s.; which, adding to 9d. an additional 3d. for the value of the egg and extras, gives the enormous profit of from 100 to 500 per cent. divided between the trader, the middleman, and the retailer. It need not be wondered at that such is the case, nor can it be otherwise while the present system continues. A poulterer whose sale is not more than 10 dozen per week, must keep a man and a horse and cart, and attend the different markets for his purchases. All these things, with incidental expenses, will amount at least to 2 guineas per week, which 2 guineas must be spread over the 10 dozen birds before he derives any profit for himself. Upon any artificial system, these expenses would be saved, and the 2 guineas thus thrown away would keep 1000 birds, averaging all ages, 1 whole week. Buildings and machinery, and other necessary apparatus being provided, no objection exists as to the expenses of hatching. An eccaleobion machine might be constructed, only requiring regulation once in 24 hours, capable of hatching throughout the year 10,000 eggs per month (a week being allowed for removing and refitting), while the cost for hatching during the month would probably be $\frac{1}{4}$ chaldron of coke at L.1 per chaldron, which would be the $\frac{1}{240}$ part of 1 farthing per bird. The expense for artificial warmth during the time the birds might require it, would be somewhat more—perhaps 1 farthing per bird." *

(2496.) I mentioned, in an extract from another writer, that the harvest-bug annoys fowls. This short account of that animal may prove interesting. "You have already, perhaps, been satiated with the account given of our enemies of the *Acarus* or *mite* tribe," says Mr Kirby or Mr Spence; "there are a few, however, which I could not with propriety introduce here, as they do not take up their abode and breed in us, which nevertheless annoy us considerably. One of these is a hexapod so minute, that, were it not for the uncommon bril-

* Bucknell's Eccaleobion, p. 1-17.

liancy of its colour, which is the most vivid crimson that can be conceived, it would be quite invisible. It is known by the name of the harvest-bug (*Acarus autumnalis*, Shaw), and is so called, I imagine, from its attacking the legs of labourers employed in the harvest, in the flesh of which it buries itself at the roots of the hairs, producing intolerable itching, attended by inflammation and considerable tumours, and sometimes even occasioning fevers." *

(2497.) In regard to the original formation of feathers in the chick of a bird, M. Raspail has the following observations. "If we examine," he says, "the epidermis of a *sparrow*, as it comes from the egg, we shall find that we can isolate each of the small bottles, which the vesicles that form the rudiments of hairs assume the shape of, as well as the nerve of which it seems to be the terminal development. It might almost be supposed that the object viewed was the eye of a *mollusca*, with its long optic nerve. The summit of this vesicle is open, even at its early period, to afford a passage for a cylindrical bundle of small fibres, which are also cylindrical, and which are nothing else than the barbs, as yet single, of the feather. If, afterwards, we examine a feather at a more advanced period, we may, by a little address, satisfy ourselves, that its tube is formed and grows by means of spathæ, one within another, of which the external ones project over the inner ones, so that the tube seems as if divided by so many diaphragms. The interstices of these diaphragms are filled with a fatty liquid, which condenses in them gradually, as the summits of the spathæ approximate and adhere to each other." †

(2498.) *Capons* of the common fowl are formed both of the cock and hen chickens, when they are fit to leave the hen, at about 6 weeks old. Chickens are transmuted into capons by destroying the testicles of the male and the ovaries of the female. The testicles are attached by a membrane to what is called the *back bone* of the carved fowl. They are destroyed by laying the bird on its near side, keeping it down, removing a few feathers, and making an incision through the skin of the abdomen, and, on introducing the fore-finger through the incision, first the one and then the other testicle is obliterated or removed altogether by it. In the case of the hen, the ovary is nipped off by the thumb-nail, or cut off by a knife. The incision is stitched up with thread, and little danger is apprehended of the result. The effect of castration is enlargement of the body of the fowl, an increased delicacy of its flesh, but its flavour is in no way improved, at least in none of the capons I have tasted. Time was when capons were more plentiful at the table than chickens, so that even kain rent was paid in them; but the conversion of fowls into capons is now abandoned as an unnecessary and troublesome operation, and will not probably be resumed as long as a well-fed delicate chicken can be procured with little trouble.

* Kirby and Spence's Introduction to Entomology, vol. i. p. 103.

† Raspail's Organic Chemistry, p. 283.

00088490

Digitized with financial assistance from the
Government of Maharashtra
on 23 January, 2019